

SELECTED
WATER
RESOURCES
ABSTRACTS



VOLUME 3, NUMBER 15
AUGUST 1, 1970

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign), single copy price is \$3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.



U.S. Department of Commerce, Springfield, Va., 22151

SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior



VOLUME 3, NUMBER 15
AUGUST 1, 1970

W70-05908 -- W70-06314

AMERICAN NATURAL RESOURCES

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

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Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

CARBON DIOXIDE, CARBONIC ACID, AND BICARBONATE ION: PHYSICAL PROPERTIES AND KINETICS OF INTERCONVERSION,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 02K.
W70-06153

02. WATER CYCLE

2A. General

INFILTRATION ANALYSIS I-INTRODUCTION,
For primary bibliographic entry see Field 02G.
W70-05916

CLIMATES OF THE WORLD.
Environmental Science Services Administration, Rockville, Md. Foreign Branch of Environmental Data Service.
For primary bibliographic entry see Field 02B.
W70-05930

STORAGE AND DELIVERY OF RAINFALL AND SNOWMELT WATER AS RELATED TO FOREST ENVIRONMENTS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Henry W. Anderson.
Proc. 3rd Forest Microclimate Symp. Seebe, Alberta, Sept. 23-26, 1969, p51-67, Canadian Forestry Service, Calgary, Alberta, March 1970.

Descriptors: *Microenvironment hydrologic cycle, *Rainfall disposition, *Watershed management, Snow management, Flood hydrology, *Forest soils, Snow cover, *Snowmelt, Interception, Retention, Soil water, Meteoric water, Condensation, Fog drip, Energy transfer, Water balance, Subsurface flow.

Identifiers: *Detention storage, Flow paths.

Accuracy of measurements of watershed inputs of rainfall, snowfall and atmospheric moisture are discussed. Outlines some of the fundamental entities of forest and water interactions, including some of the favored paths that water and energy take in the forest environment are outlined. The storage of water on forest surfaces and subsurfaces and the processes of delivery of water, as affected by forest conditions, are reviewed and discussed. The report summarizes what can be done in manipulating forests to modify snow storage and control snowmelt. (Anderson-Forest Service)
W70-06038

2B. Precipitation

CLIMATES OF THE WORLD.
Environmental Science Services Administration, Rockville, Md. Foreign Branch of Environmental Data Service.

Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 - Price \$0.35 per copy. Environmental Science Services Administration Data Service Report, January 1969. 28 p, 3 fig, 1 tab.

Descriptors: *Climates, *Climatic data, Data collections, Weather data, Temperature, Precipitation (Atmospheric).
Identifiers: World climatic data.

The principal features of climates of all the continents are discussed briefly. Worldwide temperatures and precipitation are illustrated by maps.

Monthly and annual temperatures and precipitation, including extreme temperatures, are presented in tabular form for approximately 800 stations throughout the world. Whenever possible, data are provided for at least one location in each country throughout the world. Cities in larger countries such as Canada, the USSR and the United States were selected to provide as complete a geographical coverage as possible. (Knapp-USGS)
W70-05930

A THREE PARAMETER DISTRIBUTION FOR PRECIPITATION DATA WITH A STRAIGHT-LINE PLOTTING METHOD.

Nevada Univ., Reno. Center for Water Resources Research. C. K. Stidd.
Desert Research Institute Preprint No 56, Nevada University, May 1968. 5 p, 5 fig, 2 ref. OWRR Project No A-026-NEV.

Descriptors: *Precipitation (Atmospheric), *Weather forecasting, *Data processing, *Statistical methods, Meteorological data, Sampling, Statistics, Weather data.
Identifiers: Precipitation data.

A plotting method is described which yields a straight line if cubes of data are normally distributed. Reno rainfall is used as an example, and the mathematical interpretation is discussed. Data that plot as a curved line on a rectilinear paper will often plot as a straight line on logarithmic graph paper. The straight-line plot on log-log paper gives three parameters for a generalization of the ordinary Gaussian distribution. The time distribution of point precipitation amounts is often cube-root normal. This could be due to the fact that precipitation is a product function of vertical motion, moisture and duration time. (Knapp-USGS)
W70-05961

METEOROLOGICAL SATELLITE VIEWS OF CLOUD GROWTH ASSOCIATED WITH THE DEVELOPMENT OF SECONDARY CYCLONES,

National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.

For primary bibliographic entry see Field 07B.

W70-06127

INDIRECT SENSING OF ATMOSPHERIC WATER VAPOR,

For primary bibliographic entry see Field 07B.

W70-06159

PROBABLE MAXIMUM AND TVA PRECIPITATION FOR TENNESSEE RIVER BASINS UP TO 3,000 SQUARE MILES IN AREA AND DURATION TO 72 HOURS,

Weather Bureau, Silver Spring, Md. Office of Hydrology.

Francis K. Schwartz, and Norbert F. Halfert.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price \$1.75. Hydrometeorological Report No. 45, May, 1969. 166 p, 26 tab, 95 fig, 33 ref, append.

Descriptors: *Probable maximum precipitation, *Spillway, Design criteria, *Weather patterns, Snowmelt, Water control, *Precipitation (Atmospheric), Rainfall.
Identifiers: TVA, Tennessee River, Tennessee.

Generalized procedures are developed to provide Probable Maximum Precipitation (PMP) and less extreme TVA precipitation estimates for Tennessee Watershed basins up to 3000 square miles in area and for durations to 72 hours. Specific estimates are presented for 28 basins mostly in the mountainous eastern portion of the Tennessee River Watershed. In addition, antecedent rainfall criteria are developed for use with the basic PMP and TVA precipitation estimates. These estimates

are necessary for consistent spillway design. (Stahl-Essa)
W70-06181

2C. Snow, Ice, and Frost

TRAFFIC TESTS ON PORTAGE LAKE ICE,

Cold Regions Research and Engineering Lab., Hanover, N.H.

H. W. Stevens, and W. J. Tizzard.

Available from the Clearinghouse as AD-700 130, \$3.00 in paper copy, \$0.65 in microfiche. Technical Rept., Dec 69, 70 p, Report no. CRREL-TR-99.

Descriptors: *Ice loads, *Lake ice, Ice breakup.
Identifiers: Cold weather operations, *Cold weather tests, *Floating ice, Ice formation.

A limited series of traffic tests were conducted on floating lake ice using a dual-wheel loaded to gross weights of 20,250; 28,250 and 36,250 lbs. Deflections were measured under static and moving loads on a continuous ice sheet and adjacent to a free edge. Representative samples of the ice were tested in unconfined compression, direct shear, flexure, and under a dynamic load (steady-state vibration). Crystal size and orientation were measured. An analysis of test results is presented using linear elastic theory and a method is proposed for estimating time variations of deflection.
W70-05966

STORAGE AND DELIVERY OF RAINFALL AND SNOWMELT WATER AS RELATED TO FOREST ENVIRONMENTS,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02A.
W70-06038

ANALYSIS OF A 24-YEAR PHOTOGRAPHIC RECORD OF NISQUALLY GLACIER, MOUNT RAINIER NATIONAL PARK, WASHINGTON,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07A.

W70-06143

2D. Evaporation and Transpiration

THE INFLUENCE OF WINTER CATCH CROPS ON THE WATER BALANCE OF SOIL,

R. Lutzke.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 174-180, 1968. 7 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Water conservation, *Land management, *Evapotranspiration, *Water balance, Soil texture, Soils, Forages, Lysimeters, Water consumption, Soil moisture, Water loss, Water storage.
Identifiers: *Germany, Eberswalde station.

Evapotranspiration of a sandy soil cultivated during winter with forage plants increased by about 50 mm. The experiments were conducted in lysimeters of 1 square-meter and 1.5 m deep at the lysimeter station, Eberswalde, Germany. Evapotranspiration increased from April to May amounting to about 6 mm per day. A dry spring season reduces the soil moisture content in addition to water loss due to evapotranspiration by plants. In this situation, an early harvesting of the forage plants is recommended. In this way, the water shortage for the following crops is avoided. (Carstea-USGS)
W70-05933

TURFGRASS EVAPOTRANSPIRATION,

Agricultural Research Service, Boise, Idaho; Soil and Water Conservation Research Div.; and Nevada Agricultural Experiment Station, Reno. Rhys Tovey, John S. Spencer, and Dean C. Muckel.

Field 02—WATER CYCLE

Group 2D—Evaporation and Transpiration

Agronomy Journal, Vol 61, No 6, p 863-867, November-December 1969. 2 fig, 5 tab, 9 ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Arid lands, *Turf grasses, *Lawns, Turf, Bermuda grass, Kentucky bluegrass, Fescues, Irrigation effects, Irrigation efficiency, Irrigation practices, Irrigation design, Lysimeters, Soil moisture, Water requirements, Nevada, Soil types, Loam. Identifiers: Tifway, Tifgreen, Sandy loam, Overwatering.

Even though water is relatively expensive and in short supply in arid regions, lawns are generally overwatered. In light of this fact, a study was instituted to evaluate the water requirements of turfgrasses. Since knowledge of evapotranspiration is necessary in order to design an efficient irrigation system and establish an effective schedule, turfgrass evapotranspiration was studied for three growing seasons. Stand density and color were also observed in an analysis of the amount of irrigation required to maintain the good appearance of grass in hot weather. For Nevada Blend lawngreen irrigation was necessary twice a week on sandy loam and once a week on loam soil. Weekly irrigation was sufficient for Tifway and Tifgreen burmadagrass on both loam and sandy loam soils. Water was applied to the test lysimeters at a rate of 2 surface inches (5.08 cm) per week. (Carr-Arizona) W70-06003

SEASONAL PATTERNS IN EVAPOTRANSPIRATION BY IRRIGATED ALFALFA IN THE CENTRAL GREAT PLAINS, Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.

Norman J. Rosenberg.
Agronomy Journal, Vol 16, No 6, p 879-886, November-December 1969. 6 fig, 3 tab, 2 append, 23 ref.

Descriptors: *Evapotranspiration, *Irrigation, *Environmental effects, *Alfalfa, *Great Plains, Nebraska, Semiarid climates, Lysimeters, Winds, Advection, Thermal radiation, Heat transfer, Humidity, Temperature, Air temperature, Soil temperature, Irrigation effects, Crop response, Nocturnal, Seasonal, Spring, Summer, Canopy, Radiation. Identifiers: *Potential evapotranspiration, Canopy resistance, Net radiation, Temperature inversions.

The evapotranspiration regime of irrigated alfalfa grown in eastern Nebraska varies qualitatively and quantitatively with the season. Although low temperatures may induce strong canopy resistance resulting in less evapotranspiration, evapotranspiration may exceed net radiation in early spring. The recorded maximum for this season is about 6.5 mm day super -1. In late spring the evapotranspiration rates may go as high as 12 mm day super -1, probably due to low humidity and strong local and/or regional advection. Evapotranspiration declines as summer advances and by early August it seldom exceeds net radiation. Under the hot and humid summer conditions maximum evapotranspiration is approximately 7.5 mm day super -1. During the alfalfa growing season nocturnal evapotranspiration is also common and sometimes exceeds 1 mm per night. This is caused by strong temperature inversions which transfer sensible heat downward. During the experiment precision weighing lysimeters were used to determine evapotranspiration. (Carr-Arizona) W70-06004

EVAPOTRANSPIRATION AND WATER STRESS OF BARLEY WITH INCREASED NITROGEN, California Agricultural Experiment Station, Davis.

R. E. Luebs, and A. E. Laag.
Agronomy Journal, Vol 61, No 6, p 921-924, November-December 1969. 4 tab, 16 ref.

Descriptors: *Evapotranspiration, *Moisture stress, *Barley, *Nitrogen, *Crop production, Semiarid climates, Nitrates, Nitrogen compounds.

Ammonium salts, Fertilizers, Grains (Crops), Crop response, Environmental effects, Consumptive use, Moisture uptake, Soil water, Soil moisture, Moisture availability, Turgidity, Leaves. Identifiers: *Ammonium nitrate, Leaf area index.

An experiment was undertaken to determine if moderately heavy applications of nitrogen to nitrogen-deficient soil with limited water would cause water stress and depress grain yield. When nitrogen was applied at emergence in rates of 45 and 90 kg/ha, the leaf area index of barley increased 44 and 109%, respectively, before stem elongation. Evapotranspiration was 14 and 43% higher, respectively, with the 45- and 90-kg rates in the period before and during tillering. During a 26-day dry period which followed, the barley crop with the highest leaf area index depleted the available soil water first. It also had the lowest relative leaf turgidity (52%) of the three test plots when the dry period ended. At this 90 kg/ha rate of nitrogen application, there was a 44% decrease in barley heads per unit land area and a 40% reduction in number of kernels per head. The result was a grain yield decrease of 1470 kg/ha. But at the 45-kg nitrogen application rate, yield increased by 450 kg/ha. This was undoubtedly due to having suffered less water stress than the high nitrogen plot. (Carr-Arizona) W70-06006

SOIL WATER EVAPORATION AS AFFECTED BY WETTING METHODS AND CRUST FORMATION,

Agricultural Research Service, Fort Collins, Colo.; and Colorado State Univ., Fort Collins. Dept. of Soil Science.

E. Bresler, and W. D. Kemper.
Soil Science Society America Proceedings, Vol 34, No 1, p 3-8, January-February 1970. 6 p, 7 fig, 15 ref.

Descriptors: *Evaporation, *Irrigation, *Flooding, *Rainfall, *Saline soils, Simulated rainfall, Laboratory tests, Hydraulic conductivity, Infiltration, Salts, Soil dispersants, Soil treatment, Soil structure, Soil physical properties, Soil water movement. Identifiers: Flow resistance (Soil water).

Laboratory studies showed that evaporation from soil columns which were wetted by flooding was 25-30% higher than soil wetted by rain and 30-40% higher than from soil to which NaCl was applied prior to wetting by simulated rain. About 25-35% more water evaporated from soil which was exposed to evaporation immediately following infiltration compared to soil which was exposed to evaporation 4 days after infiltration ceased. The crust which was formed at the soil surface by the raindrop action and dispersion due to sodium ion caused the wetting rate to decrease from 23 cm/hour in the flooded treatment to 1.1 in the rain and 0.06 cm/hour in the rain on NaCl treatment. Higher water content profile and shallower wetting zone resulted when rates of wetting were faster, and caused the total water loss to be higher. The total water loss was also affected by the type of crust which formed at the soil surface. (Knapp-USGS) W70-06119

2E. Streamflow and Runoff

PATTERN OF POTENTIAL FLOW IN A FREE OVERFALL,

California Univ., Davis. Dept. of Water Science and Engineering; and Pahlavi Univ., Shiraz (Iran). Dept. of Engineering.

For primary bibliographic entry see Field 08B.
W70-05909

FRICITION FACTORS AND BED FORMS IN FLUVIAL CHANNELS,

Iowa Univ., Iowa City. Inst. of Hydraulic Research. For primary bibliographic entry see Field 02J.
W70-05911

FLOOD HAZARD INFORMATION, POTOMAC RIVER AND TRIBUTARY STREAMS, STAFFORD COUNTY, VIRGINIA.

Corps of Engineers, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W70-05918

FLOOD PLAIN INFORMATION, LATTAS AND SAN DIEGO CREEKS, ALICE, TEXAS.

Corps of Engineers, Galveston, Tex.
For primary bibliographic entry see Field 04A.
W70-05919

WATERSHED HYDRAULICS IN THE LABORATORY,

Missouri Univ., Rolla. Dept. of Civil Engineering.
Terence E. Harbaugh.

Available from the Clearinghouse as PB-191 212, \$3.00 in paper copy, \$0.65 in microfiche. Missouri University Water Resources Center Report, p 500-513, 1969. 13 p, 5 fig, 19 ref. OWRR Proj No B-007-MO.

Descriptors: *Rainfall-runoff relationships, *Hydrograph analysis, *Routing, Model studies, Mathematical models, Mathematical studies, Synthetic hydrology, Watersheds (Basins), Hydrogeology, Hydraulic models. Identifiers: Watershed hydraulics.

Laboratory facilities are basic ingredients in the understanding of the hydromechanic behavior of natural watersheds. The significant variables which influence time of concentration, time to equilibrium, time to peak, lag time, etc., are readily observable, thus providing an insight into the hydromechanic behavior of watersheds. This paper is devoted to a discussion of the characteristics of the time distribution of runoff (hydrograph) with comments on lag time, time to peak, and other characteristic time responses of watersheds. Various definitions concerning the concept of time of concentration exist in hydrologic literature. The general definition, 'the time it takes a drop of water to travel from the uppermost part of the watershed to the outlet,' is shown to be in direct contradiction to the definition 'the time it takes a watershed to attain maximum discharge when subjected to a constant intensity rainfall.' (Knapp-USGS) W70-05920

FLOOD PLAIN INFORMATION OF JACKSON RIVER, COVINGTON, CLIFTON FORGE AND ALLEGHENY COUNTY, VIRGINIA.

Corps of Engineers, Norfolk, Va.
For primary bibliographic entry see Field 04A.
W70-05923

RESULTS OF THE STUDY OF MACROTURBULENT MOVEMENT DOWNSTREAM OF A HYDRAULIC JUMP (IN FRENCH),

Institute of Hydrotechnical Research, Bucharest (Romania). Hydraulics Section.

For primary bibliographic entry see Field 08B.
W70-05947

A METHOD OF DETERMINATION OF THE INTENSITY OF A STREAM MACROTURBULENCE THROUGH APPLICATION OF A THERMISTOR,

Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.

For primary bibliographic entry see Field 07B.
W70-05950

TURBULENCE CHARACTERISTICS MEASUREMENTS IN WATER FLOWS BEHIND GRIDS,

Moscow Inst. of Civil Engineering (USSR). L. S. Givotsky, N. V. Danilchenko, and V. S. Borovkov.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ., Fort Collins, Vol 2

Streamflow and Runoff—Group 2E

(Macroturbulence and stochastic processes in hydraulics), Paper B39, p 333-339, 1967. 7 p, 7 fig, 4 ref.

Descriptors: *Turbulent flow, *Turbulence, *Energy dissipation, *Model studies, Hydraulic models, Streamflow, Vortices, Eddies.
Identifiers: Isotropic turbulence, Turbulence decay.

Experimental data on the decay of isotropic turbulence in water flows are presented. Coincidence of experimental measurements and theoretical predictions was good. The turbulence intensity in water and air flows is similar. It is found that the turbulence intensity in water flow behind grids is proportional to the diameter of the rigid rods. The square of the velocity pulsation component is linearly dependent on the square of averaged velocity. (Knapp-USGS)
W70-05951

THE STEADY STATE AND DYNAMIC HEAT TRANSFER FROM TURBULENCE SENSORS IN LIQUIDS,
Purdue Univ., Lafayette, Ind.; and Tennessee Technological Univ., Cookeville.
For primary bibliographic entry see Field 07B.
W70-05952

THE EFFECT OF BEND ON THE DISTRIBUTION AND DEVELOPMENT OF THE MACROTURBULENCE INTENSITY IN OPEN CHANNEL BEDS,
Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05954

THE WATER RESOURCES OF CYPRUS -- THEIR CONSERVATION AND DEVELOPMENT,
Ministry of Agriculture and Natural Resources, Nicosia (Cyprus). Dept. of Water Development.
For primary bibliographic entry see Field 02F.
W70-05955

PROVISIONAL TIME-OF-TRAVEL FOR ILLINOIS STREAMS,
Illinois State Water Survey, Urbana.
John B. Stall, and Douglas W. Hiestand.
Available from the Clearinghouse as PB-189 701, \$3.00 in paper copy, \$0.65 in microfiche. Report of Investigation 63, 1969. 31 p, 3 tab, 9 fig, 8 ref. OWRR Project B-005-ILL.

Descriptors: *Streamflow, *Flow rates, Illinois Streams, Water pollution sources, Flow measurement, River basins, Time series analysis.
Identifiers: *Dye tracers, Hydraulic geometry, *Time-of-travel.

Provisional estimates of the time-of-travel of a contaminant material in 41 reaches of principal streams in Illinois are presented in graphical form. Computed travel times for each stream reach are shown for high, medium, and low flow conditions, representing flow frequencies of 10, 50, and 90 percent of the days per year. Time-of-travel computations were based on equations for stream velocity developed in a previous study of the hydraulic geometry of streams for 18 river basins in Illinois. Computed times-of-travel are shown to be reasonably accurate by comparison with actual times-of-travel measured by dye tracers. The computed travel times are most reliable at high flows, becoming less so at diminishing flow rates. Advance information on the time-of-travel of materials in streams becomes highly important when the contaminant endangers downstream water users. Generalized results from this study will serve as useful estimates of travel time in streams until more direct and accurate measurements can be made.
W70-06035

EFFECT OF EROSION - CONTROL LAND TREATMENT ON FLOW FROM AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Washington, D.C.
Lloyd L. Harrold, and Frank J. Dragoun.
Trans. Amer. Soc. Agric. Engin. Vol 12, No 6, p 857-861, Nov-Dec 1969.

Descriptors: *Flow, *Water yield, *Land treatment, *Agricultural watersheds, *Erosion-control, Storm runoff, Terraces.

Identifiers: *Coshocton, Ohio; *Hastings, Nebraska; *Riesel, Texas; *Treynor, Iowa; Deep loess.

Farming methods that increased the area of grass and trees effectively reduced soil erosion and caused a reduction in annual surface water yield by about 30 percent in Ohio, Nebraska and Texas. Although level bench terraces in deep loess of western Iowa had little effect on total annual water yield, its stream flow came mostly from aquifers and was distributed fairly uniformly throughout the year. On unterraced watersheds much of the flow occurred as flashy storm surface runoff. These level terraces caused noticeable reduction in flood peak discharge rates. Major flood peaks in Ohio, Nebraska, and Texas were not affected by erosion-control land treatment. Watershed modeling techniques are not yet advanced to the point of predicting downstream effects on streamflow resulting from headwaters land use changes. (Harrold-USDA, ARS)
W70-06040

LONGITUDINAL DISPERSION OF THE LOWER KANSAS RIVER BASIN,
Kansas Water Resources Research Inst., Manhattan.

Yun-Sheng Yu, and Mahendra K. Bansal.
Available from the Clearinghouse as PB-191 249, \$3.00 in paper copy, \$0.65 in microfiche. Kansas Water Resources Research Institute, Contribution No. 37, 1970. 35 p, 20 fig, 9 ref. OWRR Project A-024-KAN.

Descriptors: *Dispersion, *Reynolds number, *Dye releases, Flow velocity, Missouri River, Mississippi River, Mixing, Tracers, Channel morphology, Turbulent flow, Uniform flow, Non-uniform flow, Alluvial channels, Open channel flow.
Identifiers: Lower Kansas River Basin, Lower Missouri River, Lower Mississippi River, Empirical equation, *Kansas River basin, Turbulent dispersion.
W70-06112

The field data of dye tests in the main stem reaches of the Lower Kansas River Basin, the Lower Missouri River from Yankton, South Dakota to Kansas City, Missouri, and the Lower Mississippi River from Baton Rouge to New Orleans, Louisiana have been analyzed to determine the dispersion coefficient for each of the study reaches. An empirical equation for the dye concentration distribution is obtained. From this empirical equation, a dispersion coefficient, which gives the best fit between the computed and the measured concentration-time curves, is selected as the nearly correct value of dispersion coefficient for the reach. The dispersion coefficient is then plotted in dimensionless form versus the Reynolds number based on the average flow velocity and average depth for the reach. The result shows that these two dimensionless parameters are linearly related on a log-log paper. (McKenna-Kansas State University)
W70-06096

SOME EXPERIMENTS WITH THE HOT-FILM ANEMOMETER IN WATER,
Queen's Univ., Belfast (North Ireland). Dept. of Civil Engineering.

For primary bibliographic entry see Field 07B.
W70-06104

COMPUTATIONAL STUDY OF ACCELERATED FLOW IN A TWO-DIMENSIONAL CONDUIT EXPANSION,
Iowa Univ., Iowa City. Inst. of Hydraulic Research; and Carnegie-Mellon Univ., Pittsburgh, Pa. Biotechnology Program.
For primary bibliographic entry see Field 08B.
W70-06105

RESISTANCE STUDIES ON SMOOTH OPEN CHANNELS,
Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.

For primary bibliographic entry see Field 8B.
W70-06109

WORK-ENERGY EQUATION FOR THE STREAMLINE,
Iowa Univ., Iowa City. Coll. of Engineering.
Hunter Rouse.

ASCE Proceedings, Journal of Hydraulics Division, Vol 96, No HY5, Paper 7300, p 1179-1190, May 1970. 12 p, 4 fig, 11 ref, append.

Descriptors: *Hydraulics, *Turbulent flow, *Energy equation, Turbulence, Open channel flow, Head loss, Hydrodynamics, Boundary processes, Energy dissipation, Flow, Mathematical studies, Hydraulic jump.
Identifiers: Bernoulli theory.

The equation of energy for shear-free flow may be generalized through incorporation of the Saint-Venant terms for the work done by tangential as well as normal stresses. Although the resulting equation is conservative, a dissipative term may be introduced by substituting for the work done conservatively the difference between the total work and that done dissipatively. In the case of laminar flow, the usual Bernoulli terms for the streamline become augmented by two: one involving the energy transferred to (or work done upon) the neighboring fluid by viscous shear; and the other the viscous generation of heat. For the mean pattern of turbulent flow, the Reynolds stresses can be used to form two comparable terms; however, the dissipation term now represents the production of turbulence rather than the immediate generation of heat. Application of the equation is illustrated for three representative cases of fluid motion: two-dimensional Poiseuille flow; the boundary-layer wake of a flat plate; and the hydraulic jump. (Knapp-USGS)

W70-06112

RUNOFF AS AFFECTED BY SALT TREATMENTS AND SOIL TEXTURE,
Colorado State Univ., Fort Collins; and Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch.

W. D. Kemper, and L. Noonan.
Soil Science Society America Proceedings, Vol 34, No 1, p 126-130, January-February 1970. 5 p, 6 fig, 6 ref. OWRR Project B-008-COLO.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Soil chemistry, *Soil treatment, Laboratory tests, Model studies, Simulated rainfall, Calcium sulfate, Sodium chloride, Soil sealants, Soil surfaces, Soils, Surface sealing, Permeability.
Identifiers: Permeability control (Soils).

Runoff was measured on soils during rains applied with a rainfall simulator in the laboratory. These soils were dried and rained on again and this sequence was repeated several times with runoff measured during each rain. The texture providing maximum runoff consisted of high sand contents (50 to 80%). Higher percentages of clay and silt resulted in surface cracking and considerable infiltration through those cracks. Marked increases occurred in runoff due to NaCl treatments and decreases occurred due to calcium sulfate treatments. Since the amounts of the salts required was small (244 to 896 kg/ha) and the cost of these salts is low (approximately \$1.00/50 kg in bulk), emerg-

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

gency water control of bare surfaces using salt treatments appears to be economically feasible. (Knapp-USGS)
W70-06114

FLOODS FROM SMALL DRAINAGE AREAS IN CALIFORNIA,
Geological Survey, Menlo Park, Calif. Water Resources Div.
For primary bibliographic entry see Field 04A.
W70-06124

FLOOD PLAIN INFORMATION, CROOKED CREEK AND TRIBUTARIES, CENTRALIA, ILLINOIS.
Corps of Engineers, St. Louis, Mo.
For primary bibliographic entry see Field 04A.
W70-06156

FREQUENCY OF FLOODS IN CITY OF LIVERPOOL,
New South Wales Univ., Kensington (Australia).
C. H. Munro, F. C. Bell, and D. N. Foster.
New South Wales University Water Research Laboratory Technical Report No 68/13, December 1968. 29 p, 12 fig, 1 append.

Descriptors: *Floods, *Flood forecasting, *Frequency analysis, Estimating, Data collections, Hydrologic data, Rainfall-runoff relationships, Unit hydrographs, Synthetic hydrology, Stage-discharge relations.
Identifiers: *Australia, *New South Wales, Flood frequency.

Estimates are made from rainfall records of the peak flood discharges of all major floods which have occurred in the period 1873-1968 inclusive in Liverpool, New South Wales, Australia. Historical evidence of flood peaks is reviewed for the period 1800-1872 inclusive. The recurrence intervals of floods equal to or greater than the 1956 flood is between 30 and 50 years, and the best estimate is 38 years. Estimates are made of the peak water level gradient down the river system from Liverpool Bridge to Milperra Bridge for floods of various magnitude. Peak floods of recurrence intervals of 10, 20 and 40 years. (Knapp-USGS)
W70-06162

STATISTICAL CHARACTERISTICS OF PRESSURE FLUCTUATIONS IN THE REGION OF HYDRAULIC JUMP,
Akademiya Nauk SSSR.
For primary bibliographic entry see Field 08B.
W70-06167

MACROTURBULENCE OF FLOWS BELOW SPILLWAYS OF MEDIUM HEAD DAMS AND THEIR PROTECTION AGAINST UNDERMINING,
Vsesoyuznyi Nauchno Issledovatelskii Institut Gidrotekhniki, Leningrad (USSR).
For primary bibliographic entry see Field 08B.
W70-06169

THE EFFECT OF MACROTURBULENCE IN THE TAILWATER OF TUBULAR SPILLWAYS ON TAILWATER STRUCTURES AND LOCAL SCOURING,
Kuibishev Civil Engineering Inst., Moscow (USSR).
For primary bibliographic entry see Field 08B.
W70-06170

ANALYSIS OF RANDOM PRESSURE FLUCTUATIONS IN STILLING BASINS,
Bureau of Reclamation, Denver, Colo. Div. of Research.
For primary bibliographic entry see Field 08B.
W70-06173

OPTICAL METHOD FOR EXPERIMENTAL STUDIES ON TURBULENT FLOWS,
Vsesoyuznyi Nauchno Issledovatelskii Institut Gidrotekhniki, Leningrad (USSR).
For primary bibliographic entry see Field 07B.
W70-06174

AREAL VARIATIONS OF BED-FORM CHARACTERISTICS IN MEANDERING STREAMS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research. Emmett M. O'Loughlin, and David Squarer. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ., Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B14, p 118-127, 1967. 10 p, 4 fig, 7 ref. OWRR Project A-020-1A.

Descriptors: *Turbulent flow, *Channel morphology, *Meanders, *Alluvial channels, Statistical methods, Sand waves, Dunes, Scour, Regime, Flow, Time series analysis, Open channel flow, Vortices, Model studies, Hydraulic models.
Identifiers: *Secondary currents, Macroturbulence.

The reliability of expressions for resistance coefficients and sediment discharge in alluvial channels is open to question when they are applied to sinuous channels because no account is taken of the distorted channel section and the secondary currents induced by channel curvature. Bed-form geometry is related in a fundamental way to resistance and sediment discharge, and it is shown in this paper that channel curvature results in significant variations in bed-form geometry. Following a procedure similar to that described by Nordin and Alger, autocovariance and spectral density functions of a process defined by the bed elevation as a function of the distance along the channel are computed in several zones in a laboratory model of an alluvial channel having an equilibrium bed configuration. These data are compared with other data of the same type obtained with nominally identical flow conditions (same mean depth and mean velocity) and bed material in a straight flume. Details of spectrum computations are discussed in terms of the length of record and the variability of the estimated spectral density. Stationarity requirements indicate that future analyses should probably be made in the time domain, and in such cases the possibility of relating time and space spectra needs close examination. (Knapp-USGS)
W70-06176

THE GEORGES RIVER HYDRAULIC, HYDROLOGIC AND RECLAMATION STUDIES,
New South Wales Univ., Kingston (Australia). For primary bibliographic entry see Field 02L.
W70-06177

FRESHWATER FISHES OF CONNECTICUT,
Connecticut Univ., Storrs.
Walter R. Whitworth, Peter L. Berrien, and Walter T. Keller.
State Geological and Natural History Survey of Connecticut, Bulletin 101, 1968. 134 p, 48 fig, 7 tab, 100 ref.

Descriptors: *Fish, *Freshwater fish, *Fish taxonomy, Populations, Fish populations, Aquatic environment, Life history studies, Distribution, Connecticut, Surveys.
Identifiers: Taxonomic keys, Systematic biology.

Identification, distributional records and generalized life histories are given for 82 species among 53 genera belonging to 26 families of freshwater fishes. Freshwaters are defined as inland waters and waters entering the sea that are not included in the zone invaded by tidal movements. Collections were made at approximately 750 sampling areas; collection records were augmented by museum collections and field records of previous workers. Records were made of selected physical and chemi-

cal characteristics of the collection sites; these include stream size, gradient, bottom type, turbidity, total alkalinity, and hardness. Collection of fish species are listed in terms of these characteristics in a series of four tables. A glossary and index of common and scientific names are included. (Voigtlander-Wisconsin)
W70-06236

2F. Groundwater

HYDRAULICS OF AQUIFERS AT ALAPAH, COOLIDGE, FITZGERALD, MONTEZUMA, AND THOMASVILLE, GEORGIA,
Georgia State Geological Survey, Atlanta.
Charles W. Sever.
Georgia Geological Survey Information Circular 36, 1969. 16 p, 13 fig, 4 tab, 16 ref.

Descriptors: *Hydrogeology, *Aquifers, *Georgia, Transmissivity, Storage coefficient, Borehole geophysics, Cores, Drawdown, Water yield, Water wells, Data collections, Hydrologic data.
Identifiers: Aquifer testing, Well interference.

The results of aquifer performance tests made on four well fields tapping limestones of Miocene, Oligocene, or Eocene age show that the hydraulic properties vary greatly from one limestone aquifer to another in southwestern Georgia. Coefficients of transmissibility in the limestones ranged from 120,000 gpd per ft (gallons per day per foot) at Fitzgerald, Ga., to perhaps as much as 20,000,000 gpd per ft at Thomasville, Ga. The coefficient of storage ranged from 0.00002 to 0.003. An aquifer performance test made on sand aquifers of Cretaceous age near Montezuma, Ga., shows the coefficient of transmissibility to be about 60,000 gpd per ft and the coefficient of storage to be about 0.002. The geophysical and lithologic logs and the drawdown versus distance graphs made for the well fields described in this report should enable prediction of the amount of interference between wells and also aid in determining the proper construction and spacing of wells. (Knapp-USGS)
W70-05924

THERMAL WATERS OF SWAZILAND,

D. R. Hunter.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 165-170, 1969. 6 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Thermal waters, Mineral waters, *Springs, *Aquifers, *Groundwater, Water temperature, Water chemistry, Water utilization, Discharge (Water), Mapping, Geology, Gases, Sodium, Sulfates, Carbonates, Calcium, Trace elements, Silica, Carbon dioxide, Nitrogen.
Identifiers: *Swaziland.

Eight thermal springs with temperatures ranging from 33 to 53 deg C are known in Swaziland. Their yields are 72 to 455 cu m per 24 hours. All the springs are associated with granitic rocks of Precambrian age, often adjacent to fault or joint systems. Na, Cl, sulfate, carbonate, bicarbonate, silicic acids, nitrogen, oxygen, helium, and some argon are present in considerable amounts in the waters of these springs. (Gabriel-USGS)
W70-05926

THE THERMAL WATERS IN THE REPUBLIC OF SOUTH AFRICA,

L. E. Kent.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 143-164, 1969. 22 p, 3 fig, 3 tab, 13 ref.

Descriptors: *Thermal waters, *Mineral waters, *Springs, *Aquifers, *Groundwater, *Water tem-

perature, Boreholes, Water chemistry, Discharge (Water), Mapping, Water sources, Geology, Fissures (Geology), Water utilization, Gases, Salinity, Trace elements.

Identifiers: *Republic of South Africa.

There are 87 thermal springs and groups of springs and boreholes that discharge thermal water, assumed to be over 25 deg C, in the Republic of South Africa. The temperature of the springs ranges from 25 to 59.9 deg C. The springs are associated with faulted areas and with relatively high annual rainfalls. The thermal waters of South Africa can be subdivided into the 5 groups as follows: highly mineralized chloride-sulfate waters; moderately saline waters; temporary hard carbonate waters; alkaline sodium bicarbonate and carbonate waters; and pure or undifferentiated waters with total dissolved substances less than 0.2 g/l. The majority of thermal springs and boreholes are utilized for therapeutic purposes. (Gabriel-USGS)

W70-05927

THERMAL AND THERMO-MINERAL SPRINGS OF THE DEMOCRATIC REPUBLIC OF CONGO (IN FRENCH),

A. LeBail, and M. Buchstein.

In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 87-104, 1969. 18 p, 6 fig, 2 tab, 6 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Mapping, Geology, Structural geology, Lakes, Fissures (Geology), Water sources, Water temperature, Water chemistry, Discharge (Water), Gases, Water utilization, Trace elements.

Identifiers: *Congo Democratic Republic.

Geology and distribution of thermal and mineral springs in the Katanga and Kivu-Kibali-Ituri provinces of the Congo are discussed. Temperature, discharge, and principal mineral components of the springs in 66 areas of Katanga and 44 of Kivu-Kibali-Ituri are tabulated. The temperature of spring waters ranges from 28 to 100 deg C and the principal mineral components consist of Na Cl, Ca, K, Na, Mg, Fe, carbonate, sulfate, Hydrogen sulfide, Cl, carbon dioxide and silica. The travertine deposits of the Katanga thermal-waters are utilized for the manufacture of cement, and several springs are utilized by local population for the production of salt. (Gabriel-USGS)

W70-05928

MINERAL AND THERMAL WATERS OF CEYLON,

J. P. R. Fonseka, N. R. De Silva, V. S. Balendran, and L. K. Senewiratne.

In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 9-19, 1969. 11 p, 7 fig, 2 tab, 6 ref.

Descriptors: *Mineral water, *Thermal water, Aquifers, *Groundwater, *Springs, Geology, Radioactivity, Coastal plains, Water temperature, Discharge (Water), Water chemistry, Mapping, Carbon dioxide, Carbonates, Sulfates, Silica, Calcium, Magnesium, Sodium, Potassium.

Identifiers: *Ceylon.

At present there are nine thermal and mineral springs in Ceylon. Many of the springs are in heavy jungle and marshy land where the underlying Precambrian bedrock, is poorly exposed. The springs do not appear to have a direct association with radioactivity or recent volcanicity. The water temperature varies from 34 to 55 deg C. The spring waters contain from 0.220 to 0.990 g/l of mineral matter. Many of the springs are characterized by their relatively large contents of free carbon dioxide, Cl, Sulfate, Silica, Ca, Na, and K. (Gabriel-USGS)

W70-05929

QUANTITATIVE INTERPRETATION OF REGIONAL GROUNDWATER FLOW PATTERNS AS AN AID TO WATER BALANCE STUDIES,

Department of Energy, Mines and Resources, Calgary (Alberta).

R. Allan Freeze.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 154-173, 1968. 20 p, 6 fig, 5 tab, 10 ref.

Descriptors: *Groundwater movement, *Water balance, Steady flow, Simulation analysis, Mathematical models, Groundwater basins, Lakes, Mapping, Piezometers, Subsurface flow, Surface runoff.

Identifiers: *Canada, Saskatchewan, Good Spirit Lake.

The simulation of steady-state regional groundwater flow patterns in a three-dimensional, non-homogeneous, anisotropic groundwater basin is possible by obtaining solutions to an appropriate mathematical model. The groundwater flow patterns determined by a mathematical model analysis of the Good Spirit Lake drainage basin in east-central Saskatchewan, Canada are confirmed by field mapping of discharge phenomena and by piezometer measurements. The natural basin yield compared well with the available measurements and estimates of the other components of the water balance. A method is presented to determine the average annual groundwater component of surface runoff and average annual subsurface outflow. (Carstea-USGS)

W70-05932

THE GROUNDWATER BALANCE VARIATION IN THE EXPLORATION AND DEVELOPMENT OF ARTESIAN BASINS,

P. F. Kvartskhava.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 198-206, 1968. 9 p, 4 fig.

Descriptors: *Artesian wells, *Groundwater recharge, Wells, Aquifers, Analytical techniques, Exploration, Water yield.

Identifiers: *Groundwater balance, *Aquifer depletion, Maximum yield.

Groundwater balance of artesian basins is discussed for natural conditions and normal hydraulic and potential regimes in recharge areas. Changes in water balance of an artesian basin by a number (n) of wells, and the recovery of water balance without aquifer depletion are described. Methods are presented for determining the beginning of the depletion for artesian aquifers. Techniques are given for determining the maximum total yield of artesian wells without depletion of aquifers. (Carstea-USGS)

W70-05935

ANALYSIS OF THE GROUNDWATER HYDROGRAPH,

Josef Hofbauer.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 219-238, 1968. 20 p, 15 fig.

Descriptors: *Hydrograph analysis, *Hydrographs, Statistical methods, Hydrologic data, Reservoirs, Water storage, Aquifers, Gaging stations, Water level fluctuations.

Identifiers: Groundwater hydrographs.

Statistical methods were used to evaluate hydrologic data from about 500 stations measuring the groundwater storage reservoirs of Bavaria. The period of observation was roughly 20-30 years. The data collected from 5 connected and interrelated groundwater basins are also interpreted and graphi-

cally presented. In 1962, attempts were made to select representative gaging stations whose monthly mean hydrographs would approximate the mean value of a great number of similarly located gaging stations. The statistical selection of gaging stations may be of considerable importance for engineering purposes. (Carstea-USGS)

W70-05936

THE THERMOMETRICAL METHODS OF STUDYING GROUNDWATER,

All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).

N. M. Frolov.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 269-283, 1968. 15 p, 7 fig, 3 tab, 6 ref.

Descriptors: *Thermal properties, *Groundwater movement, *Groundwater recharge, Energy, Radioactivity effects, Uranium radioisotopes, Heat flow, Thermal water, Leakage, Karst.

Identifiers: *Thermal regime, Endogenous energy source, Exogenous energy source, Thorium.

Endogenous and exogenous energy sources are responsible for the thermal regime of the earth. The first group refers to heat generated from radioactive decay of uranium, thorium, and potassium, whereas the second source covers mostly from the sun. Groundwater is characterized by a high heat capacity and mobility. Thermometric methods for studying groundwater are based on heat and mass processes in the rock-water system. Knowledge of the hydrogeothermal regime is of prime importance in studying thermal waters. Hydrogeothermal methods are useful in solving some of the following problems related to groundwater: (1) hydrodynamic problems (movement, recharge, leakage, etc.); (2) estimation of the heat quantity transported by the groundwater from the earth's interior; (3) thickness and intensity of karst development; and (4) interaction of ground and surface waters, and other problems. Examples of these studies are discussed. (Carstea-USGS)

W70-05938

DARCY'S LAW DURING UNSTEADY FLOW,

Cincinnati Univ., Ohio, Dept. of Civil Engineering.

Louis M. Laushey, and Laxmida V. Popat.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 284-299, 1968. 16 p, 8 fig, 2 tab, 10 ref.

Descriptors: *Darcy's law, *Steady flow, *Unsteady flow, Flow rates, Permeability, Piezometers, Reynolds number, Laminar flow, Water table, Mathematical studies, Groundwater movement.

Many steady flow tests were performed over a wide range of flow rates to extend the range of validity of Darcy's law. The experimental conditions were selected in such a way that: (1) permeability was not a variable; (2) the piezometric slope was essentially constant along the tube during each test; (3) the piezometric gradient was proportional to the flow rate; (4) the maximum flow rate was at least equal to that measured during the unsteady tests; and (5) the Reynolds number was smaller than unity. Experiments with unsteady laminar flow showed that Darcy's law was incomplete unless the total derivative of the water table elevation with both distance and time was used for the gradient of the static head. A theory for unsteady flow is presented. (Carstea-USGS)

W70-05939

ARTIFICIAL RECHARGE THROUGH INJECTION WELLS IN A SANDSTONE AQUIFER,

Nebraska Univ., Lincoln.

For primary bibliographic entry see Field 04B.

W70-05940

Field 02—WATER CYCLE

Group 2F—Groundwater

EFFECT OF TOPOGRAPHY ON GROUND-WATER FLOW

California Univ., Berkeley. Dept. of Civil Engineering.

M. Shahbazi, S. Zand, and D. K. Todd.

In: *Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967)*, International Association of Scientific Hydrology, Publication No 77, p 314-319, 1968. 6 p, 4 fig, 1 tab, 6 ref.

Descriptors: *Topography, *Groundwater movement, Steady flow, Groundwater recharge, Mathematical models, Water table, Digital computers, Aquifers.

Identifiers: Hele-Shaw models.

Steady state flow patterns of groundwater in two dimensions for an unconfined homogeneous and isotropic aquifer were determined for various ground surface configurations and recharge rates. Data were obtained from a Hele-Shaw viscous fluid model and from a mathematical model with solutions obtained by employing a digital computer. Results by the two methods were compared and also with work of previous investigators. It was found that the location and elevation of low points of the ground surface configuration and the rate of recharge had a marked effect on the shape of the water table; furthermore, the areas of recharge to and discharge from the water table varied with the above parameters. (Carstea-USGS)

W70-05942

THE FONTAINE DE VAUCLUSE (IN FRENCH)

Bordeaux Univ. (France). Dept. of Hydrogeology.

Henri Schoeller, and Michel Aigrot.

In: *Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967)*, International Association of Scientific Hydrology, Publication No 77, p 320-328, 1968. 9 p, 3 fig, 4 tab, 8 ref.

Descriptors: *Groundwater movement, *Aquifers, *Springs, *Karst, Porosity, Permeability, Hydrodynamics.

Identifiers: *France, Vaucluse.

The springflow hydrodynamics may be better understood by study of the Fontaine de Vaucluse. In the aquifer supplying the spring, the porosity is 25 times and the permeability 5 times greater above the groundwater level than below it. This shows the presence of large karst cavities above the groundwater level. (Carstea-USGS)

W70-05943

NONSTEADY TWO-LAYER RADIAL FLOW TO WELLS

Indiana Univ., Bloomington. Dept. of Geology.

For primary bibliographic entry see Field 04B.

W70-05944

RHEOELECTRIC ANALOGY; STUDY OF AN ARTESIAN BASIN, APPLICATION ON THE ARTESIAN GROUNDWATER OF THE 'SABLES INFÉRIEURS D'AQUITAINE' (IN FRENCH)

Bordeaux Univ. (France). Dept. of Hydrogeology.

A. Cazal, Y. Emsellem, B. Moussie, P. Pouchan,

and H. Schoeller.

In: *Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967)*, International Association of Scientific Hydrology, Publication No 77, p 343-352, 1968. 10 p, 7 fig, 6 ref.

Descriptors: *Analog models, *Groundwater movement, Artesian wells, Model studies, Sands, Transmissivity, Observation wells, Unsteady flow.

Identifiers: *France, Aquitaine.

Rheoelectric models are useful tools for studying groundwater movement, particularly with boundary conditions, transmissivity and possibilities of water utilization. An analog model was used to show water movement in the lower sands of Aquitaine, France. The water depth in this sandy formation of Eocene age ranged between 150 and 400 meters. The transmissivity and potential data

were obtained by numerous observation wells. These data were then used to build the analog model, which can be developed for solving problems related to unsteady flow. (Carstea-USGS)

W70-05945

ON THE TECHNIQUE FOR SOLVING HYDROGEOLOGICAL PROBLEMS USING SOLID AND NETWORK ELECTRIC MODELS

All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).

V. M. Shestakov.

In: *Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967)*, International Association of Scientific Hydrology, Publication No 77, p 353-360, 1968. 8 p, 2 fig, 12 ref.

Descriptors: *Analog models, *Model studies, *Groundwater movement, Unsteady flow, Fresh water, Saline water, Saline water-freshwater interfaces, Density, Seepage, Free surfaces.

Identifiers: Two-dimensional flow.

Many important problems in hydrology can be solved by the use of analog models. Simulation of two-dimensional flow for unsteady unconfined flow and saline water-fresh water interfaces are discussed. The method of gradients is commonly used in simulating unsteady seepage for free-surface flows. The difference in densities between saline and fresh waters is very important. The rate of displacement of the interface during the calculated interval of time is determined by a graphical addition of actual seepage rates on the axes corresponding to the network direction. (Carstea-USGS)

W70-05946

THE WATER RESOURCES OF CYPRUS - THEIR CONSERVATION AND DEVELOPMENT

Ministry of Agriculture and Natural Resources, Nicosia (Cyprus). Dept. of Water Development.

C. A. C. Konteatis.

Nicosia, Cyprus, 'GEKA' Printing Enterprises, January 1967. 58 p, 10 fig, 8 photo, 9 tab, 29 ref.

Descriptors: *Water resources, *Water resources development, Surface waters, Groundwater, Reservoirs, Water law, Water rights, Topography, Climates, Water balance, Water supply, Irrigation water, Municipal water, Aquifers, Streamflow, Geology, Hydrogeology.

Identifiers: *Cyprus.

The topography, geology, and water resources of Cyprus are described and plans for the island's water resources development are outlined. The physical and climatic features of the island which control the available water resources, land resources, and crop patterns are outlined. A table shows a tentative water balance. Domestic water supplies both for rural and town needs and the future possibilities for supplementing these water supplies are described. Irrigation and other water conservation projects include groundwater recharge, river training, drainage, flood control and desalination works. Tables show the utilization of the water resources, the type of crops, the quantity of water extracted and the actual irrigation efficiency. Institutional, legal, economic and financial aspects, water laws, and the present policy on economic analyses of projects are described. The last chapter describes the prospects for future development including both the natural water resources and artificial methods for increasing water resources such as artificial rainfall, evaporation control, sewage water recovery and desalination. Tables show the water use in every hydrological catchment, the available and surplus water resources, and possible future irrigation which could be achieved from the available surplus. A diagram indicates the utilization of the water resources in the past few years, the projected possible utilization, and economic growth from irrigation. (Knapp-USGS)

W70-05955

NONSTEADY FLOW TO MULTIAQUIFER WELLS

Geological Survey, Washington, D.C. Water Resources Div.

Istavros S. Papadopoulos.

Journal of Geophysical Research, Vol 71, No 20, p 4791-4797, October 15, 1966. 7 p, 2 fig, 22 ref.

Descriptors: *Groundwater movement, *Mathematical studies, Flow, Porous media, Hydraulics, Darcys law, Permeability, Aquifers, Unsteady flow, Non-uniform flow, Porosity, Transmissivity, Drawdown, Water level fluctuations.

Identifiers: Multiaquifer wells.

The nonsteady flow toward a well open to two aquifers of different hydraulic properties is analyzed. Exact solutions to the problem are found to be intractable for numerical calculations. Therefore, asymptotic solutions which are amenable to easy computation and which yield results accurate enough for practical applications are developed. These solutions make possible the prediction of pumping levels and yields of two-aquifer wells. They also provide a basis for predicting the hydraulic head changes around such wells and the contribution of each aquifer to the total discharge of the well. (Knapp-USGS)

W70-05956

APPLICATION OF ELECTRIC WELL LOGGING AND OTHER WELL LOGGING METHODS IN HAWAII

Hawaii Univ., Honolulu. Water Resources Research Center.

Chester Lao, Frank L. Peterson, and Doak C. Cox. Technical Report No. 21, November 1969. 108 p, 4 tab, 16 fig, 49 ref, 5 append.

Descriptors: Groundwater, *Electrical well logging, *Geophysical well logging, *Porosity, *Well yield.

A comprehensive study of electric well logging and other geophysical well logging techniques in Hawaii has resulted in much basic geologic, hydrologic and geometric information from wells in Hawaiian basaltic aquifers. The functions logged include spontaneous potential, point resistivity, short and long normal resistivity, lateral resistivity, water temperature, water conductivity, and caliper. Formation resistivity and fluid conductivity in particular produced much important qualitative and quantitative information. (W70-06098)

CAVE FEATURES: INFORMATION CONCERNING THE NATURE AND GENESIS OF SOILS

Maryland Univ., College Park. Dept. of Agronomy.

For primary bibliographic entry see Field 02G.

W70-06115

DIGITAL MODEL OF ALLUVIAL AQUIFER

Nova Scotia Dept. of Mines, Halifax; and Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 06A.

W70-06130

A SUMMARY OF MINERAL AND THERMAL WATERS IN AUSTRALIA

Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

I. R. McLeod.

In: *Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries*. Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 289-292, 1969. 4 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Mineral water, *Thermal water, *Springs, *Aquifers, *Groundwater, Geology, Water temperature, Water chemistry, Chemical analysis, Water utilization, Mapping, Discharge (Water), Brines, Calcium, Magnesium, Sodium, Chlorine, Sulfates, Trace elements, Boreholes.

Identifiers: *Australia.

Some hydrological and chemical data of the Lake Eyre mound springs and of three other Australian hot springs are presented. The water in the known thermal springs is groundwater heated by circulation to deep layers. K, Na, Mg, Ca sulfate, carbonate, and Cl, are the main mineral constituents of these waters. The springs of Australia are utilized on a very small scale, although the iron ore of springs located near Mittagong, New South Wales, is mined on a relatively large scale. Underground brine is tapped and evaporated to produce common salt at Port Alma. (Gabriel-USGS)
W70-06145

LAND SUBSIDENCE DUE TO THE APPLICATION OF WATER.
Geological Survey, Sacramento, Calif.
For primary bibliographic entry see Field 08D.
W70-06150

THE MINERAL AND THERMAL WATERS OF THE TERRITORY OF PAPUA AND NEW GUINEA,
Bureau of Mineral Resources, Geology, and Geophysics, Canberra (Australia).
R. F. Heming.

In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 293-304, 1969. 12 p, 1 fig, 2 tab, 14 ref.

Descriptors: *Mineral waters, *Thermal waters, *Springs, *Aquifers, *Groundwater, Geology, Volcanoes, Mapping, Heat flow, Water temperature, Water chemistry, Chemical analysis, Water utilization, Discharge (Water).
Identifiers: *Papua, *New Guinea.

Thermal areas in Papua and New Guinea are related to volcanism or result from heat flows. The water temperature of the springs ranges from 20 to 100 deg C, and Ca, Na, K, Mg, Al, Fe, carbonate, silica, Cl, and sulfate are the main mineral constituents of their waters. Many of the thermal springs are utilized for cooking and bathing purposes. (Gabriel-USGS)
W70-06151

SPRINGS OF DEEP SEATED ORIGIN IN TANZANIA,
B. G. Walker.

Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 171-180, 1969. 10 p, 1 fig, 1 tab, 11 ref.

Descriptors: *Springs, *Aquifers, *Groundwater, *Thermal water, *Mineral water, *Water sources, Water temperature, Water chemistry, Water supply, Water utilization, Discharge (Water), Geology, Mapping, Sodium, Carbonates, Sulfates, Chlorides, Calcium, Magnesium, Silica, Potassium. Identifiers: *Tanzania.

Numerous springs in Tanzania are associated with rift valleys and faulted blocks of the rift systems. Chemical composition, temperature, discharge, and related geological features of the deep-seated springs of the region are tabulated. The temperature of spring waters ranges from 14 to over 37 deg C, and they contain some Na, K, Ca, Mg, Carbonate, Bicarbonate, Sulfate, Silica, and small amounts of CO, methane, He, and Ar. Several springs contain considerable gases, including N, carbon dioxide, and He. The brine springs at Uvinza and Ivuna are utilized for the production of salt. (Gabriel-USGS)
W70-06152

FLOW THROUGH POROUS MEDIA,
Princeton Univ., N.J.
Roger J. M. De Wiest.
New York, Academic Press, Inc. 1969. 530 p.

Descriptors: *Groundwater movement, *Flow, *Porous media, Darcys law, Porosity, Permeability, Hydraulic conductivity, Hydrodynamics, Dispersion, Unsaturated flow, Soil water movement, Saturated flow, Water table, Aquifers, Storage coefficient, Artesian wells, Mathematical models, Hydraulic models, Mathematical studies, Analog models, Bibliographies.
Identifiers: Confined aquifers, Green's functions, Immiscible fluid flow.

This book deals with the flow of fluids, especially water, through the upper layers of the earth. Topics covered include the theory of groundwater flow and storage, dispersion, unsaturated and unsteady flow, and other aspects of flow through porous media. Although some sections require a solid grasp of mathematical physics, this research-level study will appeal to all civil, petroleum, and geological engineers, and to all hydrologists. Research workers and graduate students in hydrology will find this volume a valuable up-to-date reference to contemporary developments in their field. Each of the 11 chapters is well referenced. The book has a total of 536 references; the chapter on flow of water in unsaturated soils has 244 referenced items. (Knapp-USGS)
W70-06154

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF BAKER COUNTY, FLORIDA,
Geological Survey, Jacksonville, Fla.

Gilbert W. Leve.
Florida Division of Geology Report of Investigations No 52, 1968. 24 p, 9 fig, 3 tab, 9 ref.

Descriptors: *Groundwater, *Aquifers, *Hydrogeology, *Florida, Borehole geophysics, Groundwater movement, Recharge, Potentiometric level, Water quality, Water yield, Water wells, Deep wells, Subsurface mapping, Water levels, Water utilization.

Identifiers: Baker County (Florida), Floridian aquifer, Duval County (Florida), Jacksonville.

Test drilling, borehole geophysical methods and an inventory of wells were used to obtain data on the groundwater resources of Baker County, Florida. Water supplies are obtained from three aquifers: (1) the water-table aquifer, (2) the shallow artesian aquifer, and (3) the Floridian aquifer. The Floridian aquifer, which is the greatest potential source of water, is composed of limestones of Tertiary age. It underlies all of Baker County at elevations ranging from less than 50 to more than 350 feet below sea level and is 750 to 1,000 feet thick. The water contains between 121 to 204 mg/liter carbonate hardness and 141 to 217 mg/liter dissolved solids. Potentiometric maps indicate that water probably recharges the aquifer within southern Baker County and moves radially away towards discharge areas. Some of this water moves into adjacent Duval and Nassau Counties, Florida and is discharged by numerous industrial and municipal wells. A progressive decline of the potentiometric surface of the aquifer in Baker County of 10 to 20 feet between 1945 and 1964 is related to increased discharge by wells in Jacksonville and Fernandina. (Leve-USGS)
W70-06163

GEOLOGY AND HYDROLOGY OF THE MARTINSBURG FORMATION IN DAUPHIN COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, Pa.; and Pennsylvania State Geological Survey, Harrisburg.
Louis D. Carswell, Jerrald R. Hollowell, and Lucian B. Platt.

Pennsylvania Geological Survey Groundwater Report W24, 1968. 54 p, 17 fig, 1 plate, 3 tab, 34 ref.

Descriptors: *Water resources, *Geology, *Groundwater, *Pennsylvania, Aquifers, Water wells, Water yield, Water supply, Drawdown, Specific yield, Transmissivity, Shales, Limestones, Water quality.

Identifiers: Dauphin County (Penn), Martinsburg Formation.

The Martinsburg Formation in Dauphin County, Pennsylvania, consists of shale, siltstone, sandstone, conglomerate, limestone, chert, and cherty mudstone. Groundwater occurs in the Martinsburg in secondary openings along joints, faults, and cleavage and bedding planes. The secondary openings are well developed near the surface and become progressively tighter as the depth increases. Borehole-velocity measurements and drilling data indicate that the circulation of groundwater is limited to the upper few hundred feet of strata. Groundwater is generally adequate for domestic use throughout the County. Specific capacities of domestic wells averaged 0.15 gpm per ft and ranged from 0.01 to 1.5 gpm per ft. The specific capacities of wells drilled to obtain the maximum available yield averaged 1.0 gpm per ft and ranged from 0.02 to 7.0 gpm per ft. Few wells drilled to obtain the maximum amount of water available yielded more than 100 gpm and none yielded more than 200 gpm; the average yield of these wells was about 50 gpm. Urbanization in Dauphin County has changed the flow regimen of Paxton Creek. As a result, the base flow of Paxton Creek in 1963, was sustained 26,000 gpd over normal. Groundwater in the Martinsburg Formation is of the calcium bicarbonate type. Contamination is restricted to local areas of concentrated housing and to areas underlain by limestone. (Knapp-USGS)
W70-06165

2G. Water in Soils

INFILTRATION ANALYSIS I-INTRODUCTION,
C. Toebes.

New Zealand Handbook of Hydrological Procedures, Procedure No 21, Ministry of Works, Wellington, 1969. 13 p, 13 fig, 3 tab, 7 ref.

Descriptors: *Infiltration, *Surface-groundwater relationships, *Groundwater movement, Water balance, Analytical techniques, Hydrograph analysis, Hydrographs, Water levels, Water level fluctuations.

Identifiers: Infiltration capacity.

Infiltration analysis may be carried out using rainfall and runoff data from sprinkling plots, from runoff plots, or from small natural basins. It determines the variation of infiltration with time for the duration of a storm. The variation of infiltration with time is expressed by a curve; either an infiltration-rate curve showing the variation of the rate of infiltration with time, or an infiltration-mass curve showing the variation of the mass infiltration with time. If the rainfall intensity during the storm is a rate greater than the infiltration capacity, the rate-of-infiltration curve is called the infiltration-capacity curve. (Knapp-USGS)
W70-05916

MODELLING OF INFILTRATION PROCESS IN THE ANALOG COMPUTER,
Gidrometeorologicheskii Institut, Odessa (USSR).

E. V. Terentjev.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 309-313, 1968. 5 p, 1 fig, 5 ref.

Descriptors: *Analog models, *Infiltration, *Model studies, Mathematical studies, Equations, Storm runoff, Irrigation, Computers, Economics.
Identifiers: *USSR, South Ukraine.

The differential equation proposed and applied for isotropic soil by G. A. Alekseev serves as a basis for an analog model of the infiltration process. The infiltration model results were compared to studies of storm runoff losses by means of overhead irrigation of soils in the South Ukraine. The use of a low cost universal analog computer in combination with the possibility of an easy and rapid change of the factors of the differential equation makes possible the analysis of a great number of variables at a relatively low cost. A scheme for solving the differential equation is shown and discussed. (Carstea-USGS)

Field 02—WATER CYCLE

Group 2G—Water in Soils

W70-05941

THE CHEMICAL NATURE OF THE ORGANIC MATRIX BELIEVED TO LIMIT WATER PENETRATION IN GRANITIC SOILS, Nevada Bureau of Mines, Reno. Desert Research Inst.

R. J. Morris, and Michael Natalino.

Available from the Clearinghouse as PB-191 213, \$3.00 in paper copy, \$0.65 in microfiche. Desert Research Institute Project Report No 13, Nevada University, July 1969. 13 p, 4 fig, 2 chart, 3 tab, 9 ref. OWRR Project A-025-NEV.

Descriptors: *Soil chemistry, *Organic matter, *Infiltration, *Wettability, Percolation, Permeability, Soil chemical properties, Soil physical properties, Surface tension, Wetting.

Identifiers: *Non-wettable soils.

Accumulated organic material from forest litter thought to limit water penetration in granitic soils was identified. A marked decrease in rate of soil wettability and water penetration occurs following forest fires. This effect was simulated under laboratory conditions by firing soils treated with extracts of the representative ground cover composed of pine, snowbush, and manzanita species. Infrared studies of the alcoholic extracts from dried concentrates indicated the definite presence of polymeric carboxylic acids. (Knapp-USGS)

W70-05957

NO-TILLAGE CORN - CHARACTERISTICS OF THE SYSTEM, Agricultural Research Service, Washington, D.C. For primary bibliographic entry see Field 03F.

W70-06039

TRANSLOCATION OF HYDROPHOBIC SUBSTANCES INTO SOIL BY BURNING ORGANIC LITTER, Forest Service (USDA), Glendora, Calif. Pacific Southwest Forest and Range Experiment Station; and California Univ., Riverside.

L. F. DeBano, L. D. Mann, and D. A. Hamilton. Soil Science Society America Proceedings, Vol 34, No 1, p 130-133, January-February 1970. 4 p, 3 fig, 2 tab, 8 ref.

Descriptors: *Wettability, *Soil physical properties, *Burning, *Organic matter, Wetting, Permeability, Soil properties, Sands, Soils, Soil chemistry, Soil water movement, Infiltration.

Identifiers: *Water repellent soils.

Unknown hydrophobic substances were vaporized in surface layers of litter and water repellent soil by an imposed heat treatment. The vaporized substances moved downward and condensed in different test soils where they produced a water repellent layer. The thickness of the water repellent layer in the underlying test soil increased as percent silt and clay decreased. The thickest and most intensely water repellent layer was produced in a uniform 35-mesh sand. The effect of texture on water repellency was attributed to large differences in specific surfaces of the soils which ranged from 0.0077 to 55 sq m/g. The induced water repellency was not directly related to a given amount of organic matter translocated by the heat treatment. Generally, however, the degree of water repellency increased as the amount of translocated organic matter increased in given test soil. (Knapp-USGS)

W70-06113

RUNOFF AS Affected BY SALT TREATMENTS AND SOIL TEXTURE, Colorado State Univ., Fort Collins; and Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch.

For primary bibliographic entry see Field 02E. W70-06114

CAVE FEATURES: INFORMATION CONCERNING THE NATURE AND GENESIS OF SOILS, Maryland Univ., College Park. Dept. of Agronomy. D. S. Fanning.
Soil Science Society America Proceedings, Vol 34, No 1, p 98-104, January-February 1970. 7 p, 7 fig, 1 tab, 14 ref.

Descriptors: *Karst, *Soil water movement, *Joints (Geology), *Fractures (Geology), *Fissures (Geology), Channel flow, Groundwater movement, Leaching, Caves, Limestones, Carbonate rocks, Soils, Soil formation, Soil chemistry, Soil classifications, Soil properties.
Identifiers: Karst soils.

Information about soils may be obtained from speleology, the study of caves. Some caves are shallow enough for roots of surface plants to be present in them. Cave maps and the distribution of stalactites on cave ceilings show that rock structure strongly controls the pattern of water movement through soil-rock columns. Relatively pure samples of some secondary minerals, formed at temperatures similar to those in the lower parts of overlying soils, may be obtained from caves. Dolomite seldom forms in caves, but calcite and aragonite are common. Impurities, including quartz, clay minerals, and iron oxides, are present in carbonate speleothems. Many speleothems have repeating growth increments (segments, rings). Some of these may be annual. When understood, they may give clues to, and dramatically portray, seasonal changes in the rate of flow and the composition of percolating waters. Studies of percolating waters from undisturbed soil-rock columns could be made using caves, but it would be difficult to tell what area and volume of soil and rock contributed to the percolate. (Knapp-USGS)

W70-06115

MEASURING UNSATURATED SOIL MOISTURE FLOW WITH A METER, Agricultural Research Service, Kimberly, Idaho. Snake River Conservation Research Center. J. W. Cary.

Soil Science Society America Proceedings, Vol 34, No 1, p 24-27, January-February 1970. 4 p, 5 fig, 2 tab.

Descriptors: *Soil moisture meters, *Soil water movement, Flowmeters, Instrumentation, Unsaturated flow, Hydraulic conductivity.
Identifiers: Soil moisture flowmeter.

A meter for measuring unsaturated soil moisture flow was constructed and tested in the laboratory. The meter was made from a single porous plate mounted in a thin brass cylinder. Flow through the meter was calculated from measurements of hydraulic head loss in the porous ceramic plate. The unit was calibrated in silt loam, silty clay, and loamy sand soils under nonisothermal but steady state conditions. It responded to water vapor flow induced by thermal gradients, as well as to liquid flow. Transient tests made in the silt loam soil indicated that it is possible to calibrate the meter under such conditions. Design analysis indicates that increasing the length of the cylinder reduces the sensitivity of the meter's calibration to changes in soil moisture content. (Knapp-USGS)

W70-06116

A COMPARISON OF TWO METHODS FOR DETERMINING SOIL WATER DIFFUSIVITY, Iowa State Univ. of Science and Technology, Ames. Dept. of Agronomy. H. M. Selim, Don Kirkham, and M. Amemiya.

Soil Science Society America Proceedings, Vol 34, No 1, p 14-18, January-February 1970. 5 p, 7 fig, 1 tab, 12 ref. AEC Contract AT (11-1)-1269, Report No 000-1269-17.

Descriptors: *Soil water movement, *Diffusivity, *Laboratory tests, *Soil moisture meters, *Nuclear moisture meters, Porous media, Unsaturated flow, Darcys law, Mathematical models, Hydraulic models, Permeameters.

Identifiers: Soil water diffusivity.

Two methods were used concurrently to determine the soil water diffusivity from horizontal infiltration of water into a soil column. In the first, water content measurements were taken at a fixed position as a function of time by using the gamma attenuation technique. In the second, water content distance distributions were determined as a function of distances from the water source at a fixed time by sectioning the same column. A comparison by the two methods of the diffusivity function for three soil materials showed that the first method is as reliable as the second. Agreement of the diffusivities obtained from the two methods is considered evidence of the validity of the unsaturated water flow equation. (Knapp-USGS)

W70-06117

INVERSE FORMULATION AND FINITE DIFFERENCE SOLUTION TO PARTIALLY SATURATED SEEPAGE FROM CANALS, Utah State Univ., Logan. Dept. of Civil Engineering, and Computer Sciences Corp., Richland, Wash.

Roland W. Jeppson, and R. William Nelson. Soil Science Society America Proceedings, Vol 34, No 1, p 9-14, January-February 1970. 6 p, 2 fig, 12 ref.

Descriptors: *Canal seepage, *Saturated flow, *Unsaturated flow, *Soil water movement, Computer programs, Mathematical models, Seepage, Groundwater movement, Steady flow, Unsteady flow, Flow nets.

Identifiers: Finite difference method, Partially saturated flow.

The mathematical model describing Darcian flow of water through soils approximates actual occurrences more closely when it permits regions of the flow to be partially saturated. A generally accepted relationship between effective permeability and capillary pressure is utilized to formulate and solve by inverse methods with finite differences the steady-state flow system of water through soils. The approach is applied to the problem of seepage from a canal to a water table. A computer program (FORTRAN IV) was written for solving this problem. (Knapp-USGS)

W70-06118

SOIL-WATER EVAPORATION AS AFFECTED BY WETTING METHODS AND CRUST FORMATION, Agricultural Research Service, Fort Collins, Colo.; and Colorado State Univ., Fort Collins. Dept. of Soil Science.

For primary bibliographic entry see Field 02D. W70-06119

FLOW THROUGH POROUS MEDIA, Princeton Univ., N.J.

For primary bibliographic entry see Field 02F. W70-06154

2H. Lakes

THE ECOLOGY OF PERiphyton IN WESTERN LAKE SUPERIOR: PART I - TAXONOMY AND DISTRIBUTION, Minnesota Univ., Minneapolis. Water Resources Research Center.

Jackson L. Fox, Theron O. Odlaug, and Theodore A. Olson.

Available from the Clearinghouse as PB-191 214, \$3.00 in paper copy, \$0.65 in microfiche. Minnesota University Water Resources Research Center Bulletin 14, August 1969. 127 p, 50 fig, 37 tab, 24 tab, 79 ref, append. OWRR Project No A-011-MINN.

Descriptors: *Lake Superior, *Periphyton, *Limnology, *Water quality, Bioindicators, Aquatic life, Aquatic algae, Water pollution effects.

Identifiers: Periphyton inventory (Lake Superior), Water quality indicators.

The plant portion of the epilithic periphyton of the western arm of Lake Superior was found to consist solely of representatives from three phyla of algae, the Chrysophyta, the Chlorophyta, and the Cyanophyta. Members of the phylum Chrysophyta were the most abundant organisms. Diatoms comprised over 90 per cent of the total number of organisms. The predominant genera were found to be *Synedra*, *Achnanthus*, *Navicula*, *Cymbella*, and *Gomphonema*. The mean total counts of organisms in the naturally occurring periphyton of Stony Point Bay, the primary sampling area, ranged from 497,000 per square centimeter of rock surface in 1966 to 1,470,000 per square centimeter in 1967. The biomass of the naturally occurring Stony Point Bay periphyton, in terms of dry weight, was 153 grams per square meter in 1965. The organisms found in the periphyton of the western arm of Lake Superior are indicative of clean water. The extensive shallow water area of Lake Superior supports large quantities of attached algae, which, as primary producers, form the first link in the food chain. (Knapp-USGS)
W70-05958

ON THE PRODUCTIVITY OF FIVE DANISH WATERS,

Gunnar Nygaard.

Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie, Vol 12, p 123-133, 1953. 5 fig, 3 tab.

Descriptors: *Productivity, *Primary production, *Indicators, *Measurement, Oligotrophy, Trophic level, Dissolved oxygen, Lakes, Temperature.

Identifiers: *Compound Index, Gross production, Eutrophy, Denmark, Net production, Mesotrophy, Winkler technique, Carbon-14 technique, Maucha's method.

Five Danish lakes, varying from oligotrophic to eutrophic, were studied to test the Compound Index as an indicator of the trophic level of a lake. The Compound Index is defined as the summation of species of *Myxophyceae*, *Chlorococcales*, *Centrales*, and *Euglenineae* divided by the number of species of *Desmidiae*. Index values below 1.0 presumably indicate oligotrophy, values from 1.0 to 2.5 indicate mesotrophy and values exceeding 3.0 indicate genuine eutrophy. Index values dissolved oxygen curves and estimates of primary production show good correlation at the extremes of the range of index values. Less agreement was noted for lakes in the middle range of index values; lack of agreement was attributed to the small numbers of phytoplankton species present and to differences in transparency and color of the waters. Highest correlations are found where gross production is stated in a per-area rather than a per-volume basis. Graphical and tabular data include temperature and dissolved oxygen profiles and comparisons of Winkler and carbon-14 estimates of primary production. (Voigtländer-Wisconsin)
W70-05979

A POLLUTION STUDY OF WESTERN LAKE ONTARIO,

Municipal Labs., Hamilton (Ontario).

D. H. Matheson.

Michigan University, Institute of Science and Technology, Great Lakes Research Division Publication No 9, p 15-20, 1962. 3 fig, 1 tab.

Descriptors: *Path of pollutants, *Tracers, *Water pollution sources, Lake Ontario, Coliforms, Detergents, Thermal stratification, Depth-area-duration analysis, Tracking techniques, Indicators.

Identifiers: Ammonia nitrogen tracers, Coliform bacteria tracers, Synthetic detergents tracers, Hamilton Bay (Ontario).

Ammonia nitrogen, coliform bacteria, and synthetic detergents were used as tracers to study emission and distribution of polluted water from Hamilton

Bay into Lake Ontario. Ammonia nitrogen was the most useful tracer because of concentrations of 5-6 ppm in the bay waters and its relative absence in uncontaminated lake water. Contour maps of average annual distribution of ammonia-nitrogen in western Lake Ontario for 1960 and 1961 are included. Highest levels were found near Burlington canal, along Hamilton Beach and the north shore. Patterns varied daily, depending on wind velocity and direction. High ammonia concentrations occurred in surface samples during thermal stratification due to spread of warm bay water over colder lake water. Average values of coliform organisms in Lake Ontario showed a distribution very similar to that shown by ammonia, with higher concentrations along both the beach shore and the north shore. Concentrations rapidly declined away from shore. Coliform bacteria showed a more complicated pattern than ammonia attributable to effects of previous emissions. Synthetic detergents provided a unique and useful tracer because they are not subject to removal by consumptive processes; however, their use is complicated since background concentrations can build up confusing the pattern of recent additions. (Haskins-Wisconsin)
W70-05984

IN SEARCH OF A CLEAR SOLUTION,

For primary bibliographic entry see Field 05C.

W70-05986

WASTEWATER POLLUTION AND GENERAL EUTROPHICATION OF A HYDROELECTRIC IMPOUNDMENT,

Department of Health, Rotorua (New Zealand). For primary bibliographic entry see Field 05C.

W70-05987

AN ATTEMPT TO DETERMINE THE PRIMARY PRODUCTION OF THE GREEN SULPHUR BACTERIA, CHLOROBIUM LIMICOLA NADS, (CHLOROBACTERIACEAE),

Bialystok Medical Academy (Poland). Dept. of Biology.

Bazyli Czeczuga.

Hydrobiologia, Vol 31, No 1, p 317-333, 1968. 13 fig, 18 ref.

Descriptors: *Primary productivity, *Sulfur bacteria, Temperature, Oxygen, Hydrogen sulfide, Light penetration, Optical properties, Depth, Surfaces, Chlorophyll, Carbon radioisotopes, Photosynthesis, Phytoplankton, Organic matter, Sodium compounds, Spectrophotometers, Meromixis, Hypolimnion, Epilimnion, Thermocline.

Identifiers: *Chlorobium limicola Nads, *Chlorobacteriaceae, Lake Wadolek (Poland), Lake Popowka Mala (Poland), Transparency, Assimilation, Green sulfur bacteria, Suwalki (Poland), Holomictic, Lake Kisajno (Poland), Mazurian Lake District (Poland).

Primary production of the green sulfur bacteria, *Chlorobium limicola* Nads (Chlorobacteriaceae), was studied using labelled carbon. The amount of oxygen, hydrogen sulfide, chlorophyll, water transparency at various depths, and penetration of light rays into the lake were investigated and the following conclusions reached: at the depths where hydrogen sulfide replaces oxygen and to which light penetrates, large amounts of green sulfur bacteria, *Chlorobium limicola*, occur. By means of carbon-14, it was determined that maximum assimilation of carbon occurs at the depth where *Chlorobium limicola* is present. Doubtless, carbon assimilation at that depth is due to *Chlorobium limicola*. As a result of photosynthesis of the green sulfur bacteria, the assimilation of carbon reaches 37.7 milligrams/cubic meter in Lake Wadolek and 177 milligrams/cubic meter in 24 hours in Lake Popowka Mala, Poland. Where the phytoplankton primary production in a column of water with a surface area of a square meter is considered 100%, the primary production of *Chlorobium limicola* consists of 13.4

to 168.8%. Maximum green sulfur bacteria production occurs at depth to which 1% of the light rays penetrate. (Jones-Wisconsin)
W70-05991

SECOND REPORT OF THE REGULAR LIMNOLOGICAL SURVEY OF LAKE BIWA (1967).

I. PLANKTON IN GENERAL AND PHYTOPLANKTON, Kyoto Univ. (Japan). Otsu Hydrobiological Station.

Ken-ichiro Negoro.

Memoirs of the Faculty of Science, Kyoto University, Series of Biology, Vol 2, No 1, p 72-91, 1968. 11 tab, 2 ref.

Descriptors: *Plankton, *Phytoplankton, Sampling, Volume, Depth, Surfaces, Seasonal, Copepods, Zooplankton, Distribution, Succession, Chrysophyta, Pyrophyta, Chlorophyta, Cyanophyta, Scenedesmus, Chlamydomonas, Speciation, Varieties, Lakes, On-site data collection, Distribution patterns.

Identifiers: Lake Biwa (Japan), Japan, Species composition, Limnological survey.

The 1967 Lake Biwa survey of total plankton and phytoplankton, volume of total plankton at 15 stations and 7 depth zones, volume of total plankton at the surface at 3 stations, and the mean volume of total plankton in each month during the past 10 years in the main basin, at 4 different depth zones, are presented. Using precipitated material, volume of phytoplankton may easily be read when zooplankton is composed of relatively large animals, such as Copepoda or Cladocera, and the colored phytoplankton is laid on the colorless zooplankton. Volume is difficult to read when zooplankton is composed of relatively small animals perfectly mixed with the phytoplankton, and is open to error. The volume of phytoplankton in the main basin was measured at 12 stations and 7 depth zones, as was volume ratio of phytoplankton:zooplankton. Zonal distribution, seasonal phytoplankton succession, number of species, and number of cells or colonies in the main basin are summarized together with monthly composition and distribution, species and cell (or colony) numbers derived from 3 stations at the accessory basin. (Jones-Wisconsin) (See also W70-05995).
W70-05994

SECOND REPORT OF THE REGULAR LIMNOLOGICAL SURVEY OF LAKE BIWA (1967).

II. ZOOPLANKTON, Osaka Medical Coll. (Japan).

Kokichi Yamamoto.

Memoirs of the Faculty of Science, Kyoto University, Series of Biology, Vol 2, No 1, p 92-106, 1968. 1 fig, 3 tab, 4 ref.

Descriptors: *Zooplankton, Limnology, Seasonal, Sampling, Depth, Temperature, Daphnia, On-site data collections, Lakes, Speciation, Varieties, Distribution patterns.

Identifiers: *Limnological survey, Lake Biwa (Japan), Japan, *Diffugia brevicolla* Cash, Species composition, *Trichocerca chattoni*, Plankton rotatoria, *Rattulus cylindricus*.

A list of zooplankton, resulting from the limnological survey of Lake Biwa in 1967, is presented. The number per cubic meter of various zooplankters are given, with their specific names and seasonal changes. A testacean rhizopod, described earlier as *Diffugia brevicolla* Cash, is now identified as *Diffugia (Pseudocucurbitella) pseudogramen* G Lievre et Thomas. A species of plankton rotatoria, *Trichocerca chattoni* (de Beauchamp), was collected from many localities in Lake Biwa, occurring usually above 15 meters, and especially abundant in layers less than 5 meters deep, and never collected from the neighboring lagoons; it is apparently an epilimnetic euplankton. This species had not been reported in Japan until 1964 and has seldom been reported elsewhere in the world, being first described as a new variety of *Rattulus cylindricus*.

Field 02—WATER CYCLE

Group 2H—Lakes

dricus. Morphological characteristics are briefly given. A table is included of *Trichocerca chattoni* noted in Lake Biwa, giving counts per cubic meter at the various regions, zones, and temperatures. Samples of zooplankton from the different stations were made at various depths in the southern and northern basins, and the number per cubic meter recorded. (Jones-Wisconsin) (See also W70-05994).
W70-05995

THE ALGAE OF SALINE AND FRESHWATER LAKES IN THE LOWER GRAND COULEE, WASHINGTON, Washington State Univ., Pullman. Richard W. Castenholtz. Washington State University Research Studies, Vol 28, No 4, p 125-155, 1960. 2 fig, 4 tab, 24 ref.

Descriptors: *Algae, *Lakes, *Fresh water, *Saline lakes, *Washington, Grand Coulee Dam, Marshes, Cyanophyta, Diatoms, Seasonal, Chlorophyta, Euglenophyta, Oregon, North Dakota, Marsh plants.

Identifiers: *Lower Grand Coulee lakes (Wash), Saskatchewan lakes, North Dakota lakes, Eastern Oregon lakes, Saline lake flora, Freshwater flora, Marsh epiphytes, Benthal mats, Epilithic crust formers, Salinity tolerance, Blue-green algae, Benthic plankton.

Non-planktonic algae of saline and freshwater lakes in the Lower Grand Coulee were collected. The 'salinity' of the saline lakes varied greatly while the freshwater lakes ranged from 0.25%-0.4%. The saline flora was depauperate in number of taxa but there were large amounts of benthal blue-green algae (a shifting mass of benthal-plankton) and diatoms with blue-greens forming epilithic coatings. Most blue-green algae showed little seasonality but the majority of diatoms were abundant during colder periods. The freshwater flora consisted of over 240 algal species and varieties. Blue-green algae were most abundant in summer as epiphytes in marshes, as benthal mats in open lakes, as epilithic crustformers, and phytoplankton; green algae were very common during warmer months; *Spirogyra* formed dense benthal mats. *Cladophora* was the dominant epilithic and epiphytic green alga. Diatoms were epilithic and epiphytic, forming thick yellow-brown slime on rocks and macrophytes. Salinity tolerances of various diatom species are discussed, based on distribution in lakes of the Lower Grand Coulee, Saskatchewan, North Dakota, and eastern Oregon. With continued salinity decrease in two of the Grand Coulee lakes, a considerable change in flora is expected. (Jones-Wisconsin)
W70-05999

ROLE OF BACTERIA IN THE DYNAMICS OF IRON IN LAKE KRASNOCHE, Leningrad State Univ. (USSR). Limnology Lab. V. G. Drabkova, and E. A. Stravinskaya. Microbiology Vol 38, No 2, p 304-309, 1969. 2 fig, 9 ref.

Descriptors: *Iron bacteria, *Iron, *Bacteria, Dynamics, Runoff, Dissolved oxygen, Mud, Seasonal, Winds, Stratification, Cycles, Ice, Hydrogen ion concentration, Color, Temperature, Distribution, Bottom sediments.

Identifiers: *Lake Krasnoe (USSR), Metallogenium personatum Perf, *Siderosapsa treubii* Mol, *Gallionella ferruginea* Ehrenb, *Gallionella planctonica* Ras, *Gallionella minor* Chol, *Gallionella major* Mol, *Gallionella*, Vertical stratification.

Seasonal changes of iron concentration (total, dissolved, and divalent) and content of iron bacteria in lake water were studied to clarify the role of microorganisms in the iron cycle. Seven species of iron bacteria were found in Lake Krasnoe water: Metallogenium personatum Perf, *Siderosapsa treubii* Mol, *Gallionella ferruginea* Ehrenb, *Gallionella planctonica* Ras, *Gallionella minor* Chol, *Gallionella major* Mol, and *Gallionella* sp. During winter,

surface layers of water are enriched with iron from surface runoff; in summer, during stagnation period, the oxygen-poor bottom layer of water is enriched with iron due to uptake from mud deposits. Its maximum concentration in a 1-square meter water column was observed in May. Three seasonal maxima were recorded in iron bacteria growth: during spring, summer, and fall. Spring and fall population increases coincide with isothermal periods, and the summer increase coincides with intense wind mixing of water masses after stratification period. Usually, the mass development of iron bacteria was observed at periods of open water and involved a decrease of total iron content and its reduced form, indicating a noticeable role of microorganisms in the oxidation and deposition of iron at this period. (Jones-Wisconsin)
W70-06000

TERRESTRIAL HEAT FLOW MEASUREMENTS ON LAKE TITICACA, PERU,

California Univ., San Diego, La Jolla; and Scripps Institution of Oceanography, San Diego, Calif. Marine Physical Lab.

J. G. Slater, V. Vacquier, and J. H. Rohrhirsch. Earth and Planetary Science Letters, Vol 8, No 1, p 45-54, March 1970. 10 p, 6 fig, 4 tab, 9 ref.

Descriptors: *Geothermal studies, *Heat flow, *Lakes, Thermal conductivity, Bottom sediments, Water temperature.

Identifiers: *Lake Titicaca, *Peru.

Between 29 May and 16 June, 1969, 19 successful observations of terrestrial heat flow were made with Bullard-type probes on Lake Titicaca within the 250-m depth curve. The 19 heat-flow measurements have a mean of 1.32 microcal/sq cm/sec (h.f.u.) which is slightly below the continental average. The differences of temperature gradient found at four depths in the lake sediments can be accounted for by an annual variation of the bottom water of approximately 0.02 deg C by comparing them to the computed penetration into the lake bottom of an annual sinusoidal oscillation of the bottom water temperature. At each of five stations the water column was nearly isothermal from a depth of 50 m to the bottom. Above 50 m the temperature rises, reaching about 14 deg C at the surface. Normal faults running along the axis of the lake may separate an eastern Devonian-Cretaceous province from a western Tertiary province. This boundary lies just west of Isla Soto. The mean heat flow in the Tertiary province appears to be significantly higher than in the Devonian-Cretaceous province. This difference might reflect a greater content of radioactive elements in and under the Tertiary terrain. (Knapp-USGS)
W70-06141

AN INVENTORY OF LARGE LAKES IN CALIFORNIA,

Geological Survey, Menlo Park, Calif. Water Resources Div.

J. R. Crippen. Geological Survey Open-file report, September 1969. 11 p, 1 tab.

Descriptors: *Lakes, *Surveys, *Data collections, *California, Census, Water supply, Streamflow, Limnology, Inflow.

Identifiers: California Lake Inventory.

The U. S. Geological Survey has tabulated data on 169 lakes and reservoirs in California of more than 1 square mile in surface area. Included in this tabulation are location, area and altitude of the water surface, drainage area, and principal inflow. (Knapp-USGS)
W70-06149

SPECIFIC PROBLEMS IN LAKES,

Wisconsin Univ., Madison. Dept. of Bacteriology. William B. Sarles.

Algae and Metropolitan Wastes, US Dep of Health, Education, and Welfare, Div of Water Supply and

Pollution Control; and Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Technical Report, SEC TR W61-3, p 10-18, 1961.

Descriptors: *Lakes, *Wisconsin, *Urbanization, *Productivity, *Aesthetics, Fertilization, Eutrophication, Sewage disposal, Legislation, Administration, History, Planning, Sewage treatment, Algae, Odors, Agricultural watersheds, Governments, Water pollution, Copper sulfate, Fish diseases, Industrial wastes, Diversion, Watersheds (Basins).

Identifiers: *Madison (Wis), Yahara River (Wis), Lake Mendota (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis), Lake Wingra (Wis), Stoughton (Wis), Nine Springs Treatment Plant (Wis), Middleton (Wis), Dane County (Wis), Badfish Creek (Wis), Environmental quality, Macrophytes, Nuisance conditions, Plant nutrients, Lake Monona (Wis).

The Madison, Wisconsin, five lakes (Mendota, Monona, Waubesa, Kegonsa, Wingra) have historically been subjected to influences of eutrophication, including both urban wastes and extensive agricultural drainage. The consequent obnoxious effects have prompted diverse and numerous efforts for their control, including community action, legislation, executive study, scientific research, administrative fiat, and legal action. This study is a short summary of the tangled history of activities which finally led to understanding the difference between nuisance conditions caused by pollution with solid sewage wastes and those due to pollution with plant nutrients, and, ultimately, to diversion of effluents around the chain of lakes from Madison's efficient secondary treatment plant. This case history study raises unanswered questions bearing on the possibilities of creating or extending sewerage districts to combat effects of urbanization; of improving sewage treatment to remove plant nutrients; and developing stream and lake management procedures which will control nuisance conditions without harming fish and other aquatic life. (See W70-04506) (Eichhorn-Wisconsin)
W70-06213

THE BIOLOGICAL EFFECT OF COPPER SULPHATE TREATMENT ON LAKE ECOLOGY,

Wisconsin Committee on Water Pollution, Madison.

Kenneth M. Mackenthun, and Harold L. Cooley. Wisconsin Academy of Sciences, Arts and Letters, Vol 41, p 177-187, 1952. 7 tab, 18 ref.

Descriptors: *Biology, *Effects, *Copper sulfate, *Treatment, *Lakes, *Ecology, Bottom sediments, Mud, Benthos, Wisconsin, Sampling, Contours, Depth, Oligochaetes, Toxicity, Fish, Bloodworms, Algal control.

Identifiers: Lake Mendota (Wis), Lake Monona (Wis), Lake Nagawicka (Wis), Lake Pewaukee (Wis), Chironomus, Procladius, Corethra punctipennis, Pisidium idahoense, Tendipes plumosus, Beaver Dam Lake (Wis), Delavan Lake (Wis).

These studies were designed to determine the effect of accumulated copper in bottom muds, applied as copper sulfate for algal control, on bottom dwelling organisms which are available as fish food. Although the toxic limit of copper sulfate, precipitated and accumulated in bottom muds, upon certain types of bottom-dwelling organisms could not be accurately determined in the time allotted, laboratory tests indicate that it is near 9000 parts/million copper on a dry-weight basis. Results indicate that copper accumulation in bottom muds, due to usage of copper sulfate to control algae in hard water lakes, is considerably lower in concentration than the amounts experimentally determined to have a deleterious effect on the profundal bottom-dwelling organisms studied. These studies indicated that differences occurring in the population density of bottom organisms in the four Wisconsin lakes studied are due to ecological variables within these separate bodies of water. (Jones-Wisconsin)
W70-06217

THE LIMNOLOGY OF CANYON FERRY RESERVOIR. IV. THE ESTIMATION OF PRIMARY PRODUCTION FROM PHYSICAL LIMNOLOGICAL DATA.

Montana State Coll., Bozeman. Dept. of Botany and Microbiology.

John C. Wright.

Limnology and Oceanography, Vol 6, p 330-337, 1961. 2 fig, 4 tab, 17 ref.

Descriptors: *Primary productivity, *Oxygen, Photosynthetic oxygen, Metabolism, Heat exchange, Lakes, Hypolimnion, Reservoirs, Analytical techniques, Heat budget.

Identifiers: Vertical eddy conductivity, Birgean heat budgets, Eddy coefficients, Oxygen consumption, Oxygen balance, Heat transport equation, Holomictic lakes, Oxidative metabolism, Canyon Ferry Reservoir.

The biological production and consumption of oxygen was computed as the sum of turbulent transport of oxygen and oxygen concentration at successive depths. The coefficients of vertical eddy diffusivity were calculated from heat transport equation utilizing Birgean heat budgets. The coefficients decreased with depth of epilimnion, attained the minimum values in the metalimnion, and increased in the hypolimnion. Below 5.5 meter depth, the oxygen consumption exceeded production. In the euphotic zone, oxygen production, equivalent to dysphotic zone oxygen consumption, averaged 1.01 gram oxygen/square meter per day. Considering the ratios of oxygen consumption:chlorophyll and oxygen consumption:seston, the daily respiration of euphotic zone was 1.44 gram oxygen/square meter per day and 2.01 gram oxygen/square meter per day, respectively. Gross production values approached those for black and clear bottle estimates of 3 grams oxygen/square meter per day. (Voigtlander-Wisconsin)

W70-06218

ECOLOGY AND BIOLOGICAL PRODUCTION OF LAKE NAKA-UMI AND ADJACENT REGIONS. 2. AN ATTEMPT OF COMPARING THE PRODUCTIVITY OF LAKE SHINJI-KO AND LAKE NAKA-UMI ON THE BASIS OF INPUT AND OUTPUT OF TOTAL PHOSPHORUS,

Kyoto Univ. (Japan). Otsu Hydrobiological Station.

Syuiti Mori.

Special Publication Seto Marine Biological Laboratory Series II, Part 1, p 9-19, 1964. 2 fig, 6 tab, 11 ref.

Descriptors: *Lakes, *Phosphorus, *Ecology, *Limnology, Productivity, Methodology, Rivers, Inflow, Discharge (Water).

Identifiers: Japan, Lake Shinji-ko, Lake Naka-umi, Uptake.

Total phosphorus (P) contents of two Japanese lakes and amounts of P in inlet and outlet waters were measured for one year. Productivities of the two lakes were also compared. Values of G (P assimilated by organisms) for the year were -144.7 metric tons for Shinji-ko and -243.7 tons for Naka-umi, where negative values (negative growth) indicate death and disintegration of organisms. Estimates of P input per cubic meter of water were 2.33 grams for Naka-umi and 1.02 grams for Shinji-ko. Phosphorus retention was also greater in Naka-umi (20% loss of input P versus 41% loss for Shinji-ko), thus indicating that productive activity was greater in Naka-umi. Tabular data include monthly estimates of P concentration and total P in vertical depth strata of the lakes and in inlet and outlet streams. Also included are formulae for computing total P budgets. (Voigtlander-Wisconsin)

W70-06221

FACTORS CONTROLLING PRIMARY PRODUCTIVITY, ESPECIALLY WITH REGARD TO WATER REPLENISHMENT, STRATIFICATION, AND MIXING,

Biological Station, Lunz am See (Australia).

Ingo Findenegg.

Memorie dell'Istituto Italiano di Idrobiologia, Supplement 18, p 105-119, 1965. 5 fig, 2 tab, 8 ref.

Descriptors: *Limnology, *Primary productivity, *Stratification, Lakes, Standing crop, Phosphorus, Nitrogen, Nutrients, Epilimnion.

Identifiers: Upwelling waters, Alpine lakes, Lake Constance, Kloepener See (Austria), Worthersee (Austria).

Primary production in lakes is controlled by the interaction of three groups of factors: physical, nutrient content, and interaction of organisms present. Production takes place in non-homogeneous layers; considerable gradients of temperature and concentration occur. Water replenishment of lakes has two main effects: changing physical and chemical qualities and removing a portion of the standing plankton crop from the system. Upwelling of deeper strata can also act in replenishing trophogenic layers, occurring through wind-driven tilting of the thermocline, and which can result in nutrient replacement in the photosynthetic layers. Where sharp temperature gradients result in stable thermoclines, production is limited to the epilimnion and dependent on nutrients brought up by the spring circulation. In alpine lakes, which are sheltered from wind, epilimnetic production is often less than metalimnetic production, the latter due to high transparency, sinking of seston and horizontal transport of nutrients from the littoral mud-water interface. (Voigtlander-Wisconsin)

W70-06222

EFFECT OF DIFFERENT FERTILIZERS ON YIELD OF GOLDEN SHINERS IN NEW YORK PONDS,

Cornell Univ., Ithaca, N.Y. Dept. of Conservation. John L. Forney.

New York Fish and Game Journal, Vol 15, No 1, p 112-116, 1968. 1 fig, 1 tab, 8 ref.

Descriptors: *Fertilization, *Farm ponds, *Fish farming, *Pounds fish per acre, Phytoplankton, Fish, Fish harvest, Phosphorus, Nitrogen, Standing crop.

Identifiers: *Golden shiners, *Fish culture, Manure, Notemigonus crysoleucus.

Six ponds, ranging in area from 0.21 to 4.5 acres (0.09 to 1.82 hectares), were stocked with adult golden shiners and fertilized with manure (1000 lbs/acre--1121 kilograms/hectare (kg/ha)) and inorganic 5-10-5 fertilizer (100 lbs/acre--121 kg/ha). Additional fertilizer treatments were made at two levels of application, each level applied to three ponds. Phytoplankton blooms occurred in ponds receiving highest fertilization; plankton blooms in lower-fertilized ponds were delayed and in lesser intensity. First-year standing crops of golden shiners from ponds treated with a lower level of inorganic fertilizer plus manure, averaged 208 lbs/acre (233 kg/ha) compared with 176 lbs/acre (197 kg/ha) for ponds receiving only high inorganic fertilizer treatments. Repeated experiments with different fertilizer applications yielded standing crops of 500 lb/acre (560 kg/ha) as opposed to 145 lbs/acre (163 kg/ha) for the unfertilized control pond. Addition of phosphorus was apparently the prime factor in increasing yield; addition of nitrates apparently had no effect. Effects of fertilization may be difficult to detect in 1-year studies in northern ponds. (Voigtlander-Wisconsin)

W70-06223

THE HISTORY OF THE CLADOCERAN FAUNA OF ESTHWAITE WATER (ENGLAND) AND ITS LIMNOLOGICAL SIGNIFICANCE,

Indiana Univ., Bloomington. Dept. of Zoology.

Clyde E. Goulden.

Archiv für Hydrobiologie, Vol 60, No 1, p 1-52, 1964. 8 fig, 3 tab, 76 ref.

Descriptors: *Sediments, *Crustaceans. *Paleolimnology, Productivity, History, Cores, Diptera, Varieties, Midges, Eutrophication.

Identifiers: *Cladocera, Esthwaite Water (England), Bosmina, Chironomus, Ceriodaphnia, Species diagnosis, Ostracoda.

Analysis of two sediment cores from the north basin of Esthwaite Water yielded 37 species of Cladocera of which 23 species were chydorids. Five periods of cladoceran development were noted, each being correlated with climatic or cultural changes in the drainage basin. Littoral Cladocera (chydorids) reached their greatest development during first (Allerod) period; the second period of abundance (immediate post-Glacial) showed a similar fauna. Planktonic Cladocera showed greatest abundance in the third (Boreal) period. The remaining periods of abundance corresponded with the arrival of Neolithic man and with increased agricultural activity following the Norse immigration. Associated with presumed increased eutrophication due to agricultural activities were faunal changes, including the replacement of Bosmina coregoni by B. longirostris, replacement of the Tanytarsus-Sergentia midge community by Chironomus, and appearance of one new Daphnia species and three species of Ceriodaphnia. Tabular and graphical data include occurrence of all species by depth in the core samples. (Voigtlander-Wisconsin)

W70-06224

LIMNOLOGICAL ASPECTS OF RECREATIONAL LAKES,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.

Kenneth M. Mackenthun, William M. Ingram, and Ralph Porges.

Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC, 20402, Price \$4.25. U.S. Dep of Health, Education, and Welfare, Public Health Service Publication No 1167, 1964. 176 p, 11 fig, 9 tab, 52 plates, 448 ref.

Descriptors: *Limnology, *Lakes, *Recreation, Reservoirs, Ponds, Temperature, Light penetration, Dissolved oxygen, Bicarbonates, Hydrogen ion concentration, Nuisance algae, Aquatic plants, Bottom sediments, Animals, Fish, Inflow, Outlets, Nutrients, Productivity, Photosynthesis, Eutrophication, Toxicity, Midges, Mosquitoes, Sampling, Control, Industrial wastes, Tennessee, Shore-line cover, Snails, Wisconsin, Human disease, Game birds, Technology, Population.

Identifiers: Leeches, Schistosome cercariae, TVA reservoirs, Anopheles quadrimaculatus, Madison (Wis), Psorophora ciliata, Artificial key.

This book considers the many problems associated with the recreational use of lakes, reservoirs, and ponds, and is directed toward interpretation of problems and management of the recreational lake phenomena. Chapters consider the general problem of aquatic nuisances; review the ecology of lakes, reservoirs and ponds and present information on biotic production, leading to an understanding of the scope and magnitude of basic nuisance problems; discuss nutrients from sewage and runoff and their impact on biological growths; review plant and animal pests affecting recreational water; present simple keys with illustrations for identification of some common aquatic plants; discuss the mechanics of establishing a sampling program for a lake, reservoir, or pond to determine the present state of biological growths and possibly predict future trends; and present information for control or alleviation of excessive production of biological nuisances. Knowledge of the mutual relations between organisms and their environment is necessary for instigation of an effective control program. A glossary is included. (Jones-Wisconsin)

W70-06225

POPULATION AND PRODUCTION ECOLOGY OF ZOOPLANKTON IN OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND,

Dalhousie Univ., Halifax (Nova Scotia).

Ian A. McLaren.

Field 02—WATER CYCLE

Group 2H—Lakes

Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1485-1559, 1969. 33 fig, 12 tab, 44 ref.

Descriptors: *Fjords, *Ecological distribution, *Population, *Ecology, Lakes, Life history studies, Secondary productivity, Productivity, Biomass, Zooplankton, Saline water intrusion, Marine animals, Aquatic microorganisms.

Identifiers: Ogac Lake (Canada), Pseudocalanus minutus, Oithona similis, Sagitta elegans, Aglantha digitale.

Detailed life-history studies are presented, based on collections of zooplankton from the three basins of the lake and from a fertilized polyethylene column. The most abundant copepod, *Pseudocalanus minutus*, had an annual life cycle, spawning during the period of abundant food. Number of young per brood was female-size-dependent; number of broods was independent of food supply. *Oithona similis* had a similar life cycle, but showed different food requirements. *Sagitta elegans* individuals were smaller than those in the sea; size of new generations was proportional to number of adults but food-independent. Other organisms present in the collections included the medusa *Aglantha*, ctenophores, *Eurytemora*, and bivalves. Owing to the marked seasonality of the lake, controls of population size and growth occur when food is in excess. Vertical migration may be adapted for growth and development control and to maximize rates of increase in thermally stratified waters. Total zooplankton production was estimated at 1 gram carbon/square meter per year, about 7% of primary production. Predator production ranged from 16 to 68% of herbivore production; production/biomass ratios averaged about 3:1 but wide variations occurred. The conclusion is that production can only be measured or explained with the aid of detailed, quantitative life-history studies. (Voigtlander-Wisconsin)

W70-06226

DIATOMS FROM SOME INLANDWATERS OF THE ANTARCTICA,

Kyoto Univ. (Japan). Otsu Hydrobiological Station.

Ken-ichiro Negoro.

Memoirs of the Faculty of Science, Kyoto University, Series of Biology, Vol 1, No 2, p 125-138, 1968. 39 fig, 21 ref.

Descriptors: *Diatoms, *Antarctic, Fresh water, Marine algae, Winds, Bottom sediments, Sands, Mud.

Identifiers: *Inland waters, Japanese Antarctic Research, *Navicula*, *Navicula muticopsis*, *Navicula perpusilla*, *Hantzschia amphioxys*, *Achanthes coarctata*, *Cocconeis*, *Amphora*, *Pinnularia borealis*, *Coscinodiscus*, *Diploneis Smithii*, *Amphora proteus*, *Paralia sulcata*, *Acrinocyclus birons*, *Cymbella norvegica*, *Synedra antarctica*, *Diploneis stigmatica*, *Denticula antarctica*, *Navicula austroshetlandica*.

Collection of algal material by the First Wintering Party of the Japanese Antarctic Research Expedition from some inland waters of Antarctica yielded 22 species of diatoms, half belonging to freshwater forms and half to marine forms. Strong winds may be the most effective factor in distribution of marine diatoms into the inland Antarctic waters. The major freshwater diatoms may be *Navicula muticopsis*, *Navicula perpusilla*, *Navicula austroshetlandica*, *Hantzschia amphioxys*, *Achanthes coarctata* var *elliptica*, and others. The material was collected on the East Ongul Island and Etre Island, and from pools, bottom mud, and sand, and small lakes in the Langhovde Mountains. The distributions and percentage frequency of diatoms are given together with a brief description of each species. Among these diatoms only five forms were found in all three districts. Two species, namely *Navicula austroshetlandica* and *Navicula muticopsis* appear to be endemic freshwater diatoms in the inland waters of the Antarctica, at least around the Byowa Base of the Japanese Expedition. (Jones-Wisconsin)

W70-06227

SOME QUANTITATIVE ASPECTS OF ALGAL GROWTH IN LAKE MENDOTA,

Wisconsin Univ., Madison. Dept. of Zoology.

Donald E. Wohlschlag, and Arthur D. Hasler. Ecology, Vol 32, No 4, p 581-593, 1951. 1 fig, 5 tab, 27 ref.

Descriptors: *Algae, *Plant growth, *Wisconsin, Ecology, Chemical analysis, Phytoplankton, Cyanophyta, Sediments, Plant populations, Weather, Water, Movement, Cultures, Bays, Streams, Weeds, Littoral, Winds.

Identifiers: *Lake Mendota (Wis), Pelagic areas, Horizontal Blooms, Gelatinous matter.

Diverse areas of Lake Mendota show differences in quantities of algae, both seasonally and intraseasonally. Various bay areas and stream mouths, weedy littoral, and pelagic stations within bays have characteristic algal numbers. Certain stations retain characteristics from one season to the next, others vary on a seasonal basis. Where station individuality is indicated, it is present over and above temporal variation. Algal cultures derived from sediments exhibited characteristic differences from bay to bay and from station to station within bays. Generally, the same station individualities present in cultures were present in corresponding collections from overlying waters. Coarse, sandy sediments from the same locale produced more algae when obtained prior to ice-free spring circulation. The possible significance of blue-green algae to subsequent blooms is discussed. Algal concentrations appear greater at a littoral area after 48-hour onshore wind than at a similar unexposed area. Chlorophyll, chemical, and microscopic data suggest that sudden appearance of *Diplocystis aeruginosa* is accompanied by increase in gelatinous matter proportionately greater than increase in activity represented by chlorophyll increase. Wind produced sediment agitation is a possible agent in production of blue-green blooms relative to seasonal succession of algal blooms. (Jones-Wisconsin)

W70-06229

PRIMARY PRODUCTION AND WATER QUALITY IN SMITH MOUNTAIN LAKE, VIRGINIA,

Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.

G. M. Simmons, Jr., and S. E. Neff.

Proceedings of the 17th Southern Water Resources and Pollution Control Conference, p 288-299, 1968. 5 fig, 2 tab, 12 ref. OWRR Project A-012-VA.

Descriptors: *Primary productivity, *Lakes, *Virginia, Reservoirs, Water pollution, Eutrophication, Oligotrophy, Water chemistry, Temperature, Hydrogen ion concentration, Dissolved oxygen, Thermal stratification, Hypolimnion, Photosynthesis, Water quality, Coliforms, Colorimetry, Nutrients, Lake morphology, Sewage effluents, Pumped storage, Hydroelectric power, Oxygen demand, Epilimnion.

Identifiers: *Smith Mountain Lake (Va), Appalachian Power Company, Alkalinity, Electrical-resistance thermometry, Winkler technique, Oxygen electrodes, Physical limnology, Bathythermograph, Potentiometry, Radiocarbon uptake techniques, Roanoke River, Blackwater River, Metalimnion, Water monomictic lakes, Mean probable number technique.

Smith Mountain Lake, Virginia, is the upper reservoir of a two-reservoir, pumped-storage hydrogeneration system, which briefly recycles about 8000 cubic feet/second of water. Among morphometric data presented in the report, most pertinent are: area-22,058 acres; depth (maximum)-200 feet, (mean)-57 feet; volume-1,254,671 acre-feet; normal usable storage-150,000 acre-feet. Effects of recirculation on thermal stratification, water quality, and primary productivity at four stations in the impoundment were studied by standard limnological methods. Becoming homothermous in late October and circulating throughout winter, impoundment behaves

as a warm monomictic lake. Although summer stratification is established, its intensity near the dam is reduced by periodic pump-back operation. Recycling also increases coliform count near dam, since some water from Pigg River-receiving untreated municipal sewage—is also repumped. Hypolimnetic oxygen is not completely exhausted, although ability of reservoir to metabolize allochthonous oxidizable matter will probably decrease with time. As determined from radiocarbon uptake, primary productivity is characteristic of oligotrophy, except in impoundment arm influenced by Roanoke-Salem urban area, where carbon assimilation is similar to that in lakes undergoing eutrophication from effluents. (Eichhorn-Wisconsin)

W70-06230

THE SHARE OF ALGAE, BACTERIA AND TRYPTON IN THE FOOD OF THE PELAGIC ZOOPLANKTON OF LAKES WITH VARIOUS TROPHIC CHARACTERISTICS,

Warsaw Univ. (Poland). Dept. of Hydrobiology.

Z. M. Gliwicz.

Bulletin de l'Academie Polonaise des Sciences (Serie des Sciences Biologiques) Vol 17, No 3, p 159-165, 1969. 3 fig, 1 tab, 8 ref.

Descriptors: *Feeding rates, *Trophic level, *Algae, *Lakes, Bacteria, Zooplankton, Foods, Rotifers, Daphnia.

Identifiers: *Feeding studies, Cladocerans, Keratella, Bosmina, Chydorus, Eurytemora, Trypton.

Feeding experiments, utilizing in situ experimental chambers were performed on zooplankton populations of five lakes. The lakes varied from eutrophic to 'meso-oligotrophic' and diversity in zooplankton density ranged from 16,000 animals/square decimeter (mesotrophic) to 114,000 (eutrophic). Numbers of zooplankton per liter varied from 40 (meso-oligotrophic) to 268 (eutrophic). Grazing intensities and Ivlev's coefficient of food selectivity were calculated for all experiments, the latter from filtration experiments involving sand suspensions. Results indicate that in eutrophic lakes, rotifers and small cladocerans (*Bosmina*, *Chydorus*) are dominant and tend to feed extensively on minute (2-6 microgram) food particles. In more oligotrophic lakes, filtering copepods (*Eudiaptomus*, *Eurytemora*) assume higher proportions and incline to feed on larger (6-10 microgram) food particles. The conclusion is that, subject to the modifying action of numerical preponderance of algae and bacteria as food sources (i.e., the extent of net primary production), the specific composition of zooplankton communities is the main factor determining food selectivity of such communities. (Voigtlander-Wisconsin)

W70-06232

THE PRODUCTION OF ORGANIC MATTER BY THE PHYTOPLANKTON IN A DANISH LAKE RECEIVING EXTRAORDINARILY GREAT AMOUNTS OF NUTRIENT SALTS,

Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.

E. Steemann Nielsen.

Hydrobiologia, Vol 7, p 68-74, 1955. 2 fig, 4 ref.

Descriptors: *Nutrients, *Phytoplankton, *Productivity, Primary productivity, Water pollution effects, Sewage, Lakes, Carbon dioxide, Photosynthesis, Organic matter, Plankton, Phosphates.

Identifiers: Gross productivity, Denmark, Søllerød Sø (Denmark), Glucose.

Production of organic matter (glucose) was studied using the Gran method (light-dark bottles) in Søllerød Sø near Copenhagen. The lake receives large quantities of sewage effluent, resulting in minimum phosphate concentrations as high as 200 milligrams phosphorus pentoxide per square meter. Actual photosynthesis (gross production) calculated as carbohydrate/square meter of surface per day ranged from zero to nearly 10 grams glu-

Erosion and Sedimentation—Group 2J

cose/square meter per day. Peaks in production were noted in May, July (highest production) and September. Annual gross production was estimated to be 1300 grams glucose. Calculations suggest that maximum production was noted, since greater production would, through carbon dioxide consumption, increase pH to levels injurious to phytoplankton. Uptake of atmospheric carbon dioxide by the lake was estimated at 60 to 100 grams carbon dioxide/square meter of surface per month during the most productive season. The conclusion is that such uptake is the actual limiting factor for production of organic matter in the lake. (Voigtlander-Wisconsin)
W70-06233

FRESHWATER FISHES OF CONNECTICUT,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 02E.
W70-06236

2I. Water in Plants

SOIL NITRATE, SOIL WATER, AND GRAIN YIELDS IN A WHEAT-FALLOW ROTATION IN THE GREAT PLAINS AS INFLUENCED BY STRAW MULCH,
Agricultural Research Service, Mandan, N. Dak.
Northern Plains Branch.
D. E. Smika, A. L. Black, and B. W. Greb.
Agronomy Journal, Vol 61, No 5, p 785-787, September-October 1969. 2 fig, 3 tab, 5 ref.

Descriptors: *Fallowing, *Mulching, *Soil water, *Crop production, *Semiarid climates, Great Plains, Crop response, Stubble mulching, Evaporation control, Water conservation, Water management (Applied), Soil-water-plant-relationships, Colorado, Montana, Nebraska, Wheat, Grains (Crops), Nitrates, Nitrogen, Nitrogen compounds, Fertilizers, Nutrient requirements.
Identifiers: *Soil nitrates, Bare fallow.

An experiment was undertaken to study the effects of straw mulch on soil nitrates and soil water in semiarid areas such as the Great Plains. At test sites in Colorado, Montana, and Nebraska it was found that mulch rates had to exceed 3,360 kg/ha before a significant reduction in soil nitrates occurred. Grain yield was not affected even at these lowered nitrate levels. In contrast, stored soil water at seeding correlated positively with wheat grain yield in 7 out of the 11 crop years under study. For the other 4 years there was no evidence that the decreased grain yield was caused by inadequate nitrogen supply. Although soil water and soil nitrate levels at end of fallowing are both very important factors in sustained crop production in semiarid areas, soil water exerts greater influence on grain yield. (Carr-Arizona)
W70-06002

TURFGRASS EVAPOTRANSPIRATION,
Agricultural Research Service, Boise, Idaho; Soil and Water Conservation Research Div.; and Nevada Agricultural Experiment Station, Reno.
For primary bibliographic entry see Field 02D.
W70-06003

MONITORING COTTON PLANT STEM RADIUS AS AN INDICATION OF WATER STRESS,
Texas Agricultural Experiment Station, College Station.
L. N. Namken, J. F. Bartholic, and J. R. Runkles.
Agronomy Journal, Vol 61, No 6, p 891-893, November-December 1969. 3 fig, 4 ref.

Descriptors: *Soil-water-plant relationships, *Moisture stress, Plant tissues, *Cotton, Drying, Moisture, Soil moisture, Plant physiology, Leaves, Instrumentation.
Identifiers: *Stem radius, *Leaf water potential, *Transducer, *Energy load, Stem.

Most methods of monitoring plant water stress are not only intermittent, but also destructive of plant tissue. In a new technique, microchanges in cotton plant stem radius during a drying cycle were measured with a linear variable displacement transducer. Degree of leaf water stress was directly related to plant stem contraction and stem radius was quite responsive to energy load changes at the evaporating surface. With the transducer it was possible to monitor relative plant water stress continuously without destroying plant tissue. (Carr-Arizona)
W70-06005

PERSISTENT, VERTICAL-MIGRATION RHYTHMS IN BENTHIC MICROFLORA. VI. THE TIDAL AND DIURNAL NATURE OF THE RHYTHM IN THE DIATOM *HANTZSCHIA VIRGATA*,
New York Univ., N.Y. Dept. of Biology; Marine Biological Lab., Woods Hole, Mass.; and Bristol Univ. (England). Dept. of Botany.
John D. Palmer, and Frank E. Round.
Biological Bulletin, Vol 132, No 1, p 44-55, 1967. 4 fig, 27 ref.

Descriptors: *Vertical migration, *Tides, *Diatoms, *Benthos, Intertidal areas, Protozoa, Sands, Euglena, Diurnal.
Identifiers: *Vertical migration rhythms, *Tidal rhythms, *Lunar-day rhythms, Ebb tides, Metazoa, Tidal exposure, Hantzschia, Barnstable Harbor (Mass), Hantzschia virgata.

During daytime low tides, sands of Barnstable Harbor, Massachusetts, attain green or golden brown coloration due to surface accumulation of the diatom *Hantzschia virgata*. With return of the tide, the organisms re-burrow into the sand. Shading of the area with opaque covering precludes emerging of the diatoms. When the low tide approaches sunset, the cells rephase their rhythm to early morning. It is postulated that migration rhythm is influenced by a lunar-day clock which measures 24.8 hours. (Wilde-Wisconsin)
W70-06235

2J. Erosion and Sedimentation

STILL-CONCENTRATED FLOW TRANSITIONS AND EXTENT OF EROSION,
City Coll., New York. Dept. of Civil Engineering.
Walter Rand.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7212, p 927-939, April 1970. 13 p, 10 fig, 1 tab, 6 ref, append.

Descriptors: *Erosion, *Open channel flow, *Hydraulic jump, *Transition flow, *Flow control, Hydraulics, Scour, Canals.
Identifiers: Sills (Hydraulic).

The distance is determined over which scour will develop downstream of a sill-controlled flow transition in an erodible open channel, in which the sediment motion is impending. This determination is based on the concept of dynamic similarity that makes it possible to relate the erosion length in an erodible channel to the total length of flow transition in a fixed-bed channel. Accordingly, prediction of the limiting extent of erosion becomes possible for a wide variety of sill-controlled flow transitions, including the case present in the hydraulic jump stilling basins, and the natural hydraulic jump. (Knapp-USGS)
W70-05908

FRICITION FACTORS AND BED FORMS IN FLUVIAL CHANNELS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
David Squarer.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7245, p 995-1017, April 1970. 23 p, 3 fig, 3 tab, 16 ref, append.
OWRR Project A-020-IA.

Descriptors: *Channel morphology, *Fluid friction, *Roughness (Hydraulic), *Meanders, *Sediment transport, Model studies, Hydraulic models, Ripple marks, Sedimentary structures, Statistical methods, Sediment discharge, Discharge (Water).
Identifiers: Stream bed geometry.

Bed-form geometry in a curved channel and a straight flume which are subject to the same nominal flow conditions is investigated by statistical analysis of records of stream bed profiles. A quantitative comparison between bed geometry in curved and straight channels is made in terms of the autocorrelation, spectral density and probability density function of a process defined by the bed elevation. The same statistical functions are used to evaluate the bed-friction factor and ripple celerities. It has been found from experiments that the total rate of sediment transport in the curved channel is approximately 15 times as much as that of a straight flume which is subject to nominally identical flow conditions. (Knapp-USGS)
W70-05911

ANALYSIS OF DATA ON SUSPENDED SEDIMENT DISCHARGE IN SEVERAL STREAMS IN ISRAEL,
Hebrew Univ., Jerusalem (Israel). Dept. of Geography.
M. Negev.
Israel Hydrological Service, Hydrological Paper No 12, 1969. 27 p, 7 fig, 9 tab, 7 ref, 2 append.

Descriptors: *Sediment transport, *Alluvial channels, *Arid lands, *Sediment load, Bed load, Suspended load, Sediment discharge, Discharge (Water), Sampling, Stream gages, Sedimentation, Data collections, Data processing, Regression analysis.
Identifiers: *Israel.

An analysis was conducted of some recently collected sediment data from six streams in Israel. In four of the streams sediment load is highly correlated with discharge alone, while in two streams a distinction between rising and falling stages, or an inclusion of 'between flood' variables improve the correlation. The sediment transport characteristics of the streams were compared with some properties of the watersheds. Hydrological and physical features of the watersheds provide plausible explanations for the observed trends. (Knapp-USGS)
W70-05925

THE BEHAVIOUR OF THE TURBULENT FLOW IN A 2-DIMENSIONAL OPEN CHANNEL IN PRESENCE OF SUSPENDED PARTICLES,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau und Erdbau.
Albert Gyr.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ., Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B2, p 9-16, 1967. 8 p, 3 fig, 5 ref.

Descriptors: *Turbulence, *Suspended load, Sediment transport, Vortices, Viscosity, Mathematical studies, Model studies, Mathematical models, Fluid friction.
Identifiers: Turbulence-suspended load relations.

The influence which particle suspensions have upon the turbulent flow character of a two-dimensional open channel flow is discussed. The decay of frictional resistance brought about by increasing the concentration of suspended material is investigated. A vortex model for the single turbulence ball is introduced which explains that the concentration of the suspended material and the viscosity is considerably variable, so that vortex diffusion is increased. This diffusion causes energy transfer from small to large vortices. This energy transfer is directly correlated with turbulent energy dissipation, which explains the connection between

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the vortex model and frictional loss. Nevertheless it should be emphasized that this is a heuristical reflection, and no quantitative statements may be made. (Knapp-USGS)
W70-05948

EFFECT OF EROSION - CONTROL LAND TREATMENT ON FLOW FROM AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-06040

THEORETICAL STUDY OF HIGH-RATE SEDIMENTATION,
Camp, Dresser and McKee, Boston, Mass.
For primary bibliographic entry see Field 05D.
W70-06059

NONEQUILIBRIUM TRANSPORT OF SUSPENDED SEDIMENT,
Missouri Univ., Columbia. Dept. of Civil Engineering.

A. T. Hjelmfelt, and C. W. Lenau.
Available from the Clearinghouse as PB-191 247, \$3.00 in paper copy, \$0.65 in microfiche. Missouri University Water Resources Center Report, 1969. 28 p, 6 fig, 10 ref, 9 append. OWRR Project No A-017-MO.

Descriptors: *Sediment transport, *Erosion, *Scour, *Suspended load, *Mathematical studies, Mathematical models, Sediment discharge, Sediment load, Equilibrium.
Identifiers: Nonequilibrium sediment transport.

Nonequilibrium suspended sediment transport is analyzed mathematically as a steady state phenomenon. Sediment-free water is assumed to enter a movable-bed channel and pick up sediment until equilibrium is reached. Curves of constant concentration are plotted. (Knapp-USGS)
W70-06097

SHIFTS OF SEDIMENT CONCENTRATION IN A VERTICAL PIPE,
Aberdeen Univ. (Scotland). Dept. of Engineering. B. B. Willets.

Journal of Hydraulic Research, Vol 8, No 1, p 109-122, 1970. 14 p, 5 fig, 4 graph, 10 ref.

Descriptors: *Sediment transport, *Laboratory tests, *Model studies, *Turbulent flow, Pipe flow, Turbulence, Diffusion, Particle size, Sedimentology.
Identifiers: Turbulent shear flow.

In order to observe the effect of transverse fluid forces on a particle in turbulent shear flow unobscured by a parallel gravity effect, a weak suspension of particles was circulated round a pipe loop with two long, vertical legs. Systematic shifts of concentration were observed in the vertical legs which could be attributed neither to symmetrical diffusion nor entirely to excess normal stress away from the boundary. An explanation of the results is offered based on the simultaneous action of excess normal stress and a lateral force due to circulation round each particle. (Knapp-USGS)
W70-06106

DIFFUSION OF SEDIMENT IN DEVELOPING FLOW,

State Univ. of New York, Buffalo. Dept. of Engineering and Applied Science.

Robert P. Apmann, and Ralph R. Rumer, Jr.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7018, p 109-123, January 1970. 15 p, 7 fig, 4 tab, 12 ref, append.

Descriptors: *Sediment transport, *Turbulent flow, *Diffusion, *Hydraulic models, *Mathematical models, Model studies, Vortices, Eddies, Turbulence, Sampling, Suspended load, Roughness (Hydraulic), Mixing.

Identifiers: Eddy diffusion.

The suspension of sediment particles by turbulent eddy diffusion in a nonuniform flow region was studied, using the convective-diffusion equation as a mathematical model. A simplified form of the equation for which mixing characteristics and flow velocities were assumed uniform was found to accurately describe the sediment concentration profiles which had been measured in a 24-ft long flume. Although diffusivities in the nonuniform region tended towards uniformity with downstream distance the vertical diffusive transport rate was related to depth as a power law function. Measured diffusion coefficients were found to depend on the relative roughness of the mobile bed. (Knapp-USGS)
W70-06108

SEDIMENT MEASUREMENT TECHNIQUES: C. ACCELERATED VALLEY DEPOSITS.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7269, p 1157-1166, May 1970. 10p, 1 fig, 2 tab, 11 ref.

Descriptors: *Deposition (Sediments), *Erosion, *Alluvial channels, *Urbanization, *Accelerated erosion, Stream erosion, Sedimentation, Sediment load, Measuring, Surveys, Investigations, Mapping, Valleys, Sediments, Research and development, Instrumentation, Stratification, Data collections, Data processing.

Identifiers: Valley deposits (Sediments).

Culturally accelerated deposition of sediment in alluvial valleys has been recognized in the U.S. since 1801 or earlier. Such deposition is most common in valleys with drainage areas smaller than a few hundred square miles, where there has been upland gullyling, and where substantial proportions of sand were available. The modern sediment deposit may be recognized by texture, color, compaction, distinctive minerals, buried artifacts, or stratification. These deposits are measured using base maps, surveying, boring, mapping, and sampling. Guidance is given in calculating volumes, tabulating, interpreting, and reporting the data obtained. (Knapp-USGS)
W70-06110

MUD VOLCANOES IN NEW ZEALAND,
British Petroleum Company Ltd., Bangkok (Thailand).

M. F. Ridd.
American Association of Petroleum Geologists Bulletin, Vol 54, No 4, p 601-616, April 1970. 16 p, 13 fig, 49 ref.

Descriptors: *Mud, *Volcanoes, *Pore pressure, *Sediments, *Structural geology, Sedimentary structures, Fissures (Geology), Folds (Geology), Geologic control, Hydrogeology, Faults (Geology).
Identifiers: *Mud volcanoes, *New Zealand.

Quiescent and eruptive mud volcanoes are present on the Raukumara Peninsula of New Zealand. They extrude early Tertiary bentonitic mud with a few boulders from beneath a cover of late Tertiary sedimentary rocks, of which the aggregate thickness is about 20,000 ft (6,100 m). The quiescent ones are low cones and mounds of soft mud and they emit saline water and natural gas, mainly methane. Eruptions of the Hangaroa River and Mangaehu Stream mud volcanoes have been violent, and in 1930 the latter threw mud and rocks about 300 ft (92 m) into the air. Other violent disturbances off the east coast are interpreted as submarine mud-volcano eruptions. Neither the pressure of natural gas being formed nor tectonic pressure alone can account for their occurrence, and it is believed, instead, that they are the surface manifestation of abnormally high pore-fluid pressures caused by compaction. If mud volcanoes are an indication of abnormally high pore-fluid pressures, then they may provide a clue to the tectonic history of the areas in which they are found. (Knapp-USGS)
W70-06125

SEDIMENTARY ENVIRONMENT AND SEDIMENTS OF COOK INLET, ALASKA,
Alaska Univ., College Inst. of Marine Science.
For primary bibliographic entry see Field 02L.
W70-06129

DISPERSAL OF MISSISSIPPI SEDIMENT IN THE GULF OF MEXICO,
Texas A and M Univ., College Station. Dept. of Geology.

David K. Davies, and Richard W. Moore.
Journal of Sedimentary Petrology, Vol 40, No 1, p 339-353, March 1970. 15 p, 16 fig, 2 tab, 20 ref.
USGS Contract No 14-08-0001-10866 and Project 15265, Texas A and M.

Descriptors: *Sediment load, *Mississippi River, *Deltas, *Provenance, *Gulf of Mexico, Deposition (Sediments), Sedimentology, Sedimentation, Mineralogy, Dispersion, Stratigraphy, Sampling.

Pleistocene and Recent Mississippi sediments possess a distinctive heavy mineral assemblage which retains its identity between Cairo, Illinois and the Gulf of Mexico Abyssal Plain. Thus this assemblage may be used to trace the Mississippi contribution to the Gulf of Mexico from fluvial, through deltaic, neritic and bathyal, to abyssal environments. Significant changes in the heavy mineral assemblage of sediments in the Gulf are related to source changes and not to the reworking or selective sorting of Mississippi sediments. As a result, three distinct sediment input sources may be recognized for detrital sediments in the Gulf of Mexico Abyssal Plain, (1) The Mississippi, (2) the Rio Grande, and (3) the rivers of northeast Mexico. The Mississippi contribution is dominant and is only replaced by other inputs in the northwest and southwest corners of the abyssal plain. On the Louisiana-Texas Inner Continental Shelf, Mississippi sediment forms a veneer which extends between the present delta and the Sabine River. Dredge samples reveal that underlying sediments were derived from the central Texas rivers to the west, probably during a period of regression which occurred between 10,000 and 7,000 B.P. The interaction of a high zircon content and intense selective sorting in the Inner Continental Shelf sediments has resulted in two areas of zircon enrichment which may be of economic significance. Because of the insensitivity of the heavy mineral assemblage of the Mississippi contribution to processes of selective sorting and reworking, only 200 non-opaque grains from one size fraction of one sample are needed to characterize this contribution. (Knapp-USGS)
W70-06131

SCOUR AND FILL PROCESSES IN A DEEP RIVER HOLE, OHIO RIVER, LOUISVILLE, KENTUCKY,
Kentucky Univ., Lexington.

Bruce R. Moore.
Journal of Sedimentary Petrology, Vol 40, No 1, p 449-455, March 1970. 7 p, 7 fig, 1 plate, 9 ref.

Descriptors: *Scour, *Stream erosion, *Ohio River, Dredging, Sediment transports, Rivers, Floods, Streamflow, Alluvial channels, Erosion, Model studies, Hydraulic models.

Identifiers: Louisville (Ky), Scour holes, Dredge holes.

A deep hole produced in the Ohio River by suction dredging was measured over a period of two years before and after high water periods. The hole did not fill, but scoured slightly deeper after each high water and the walls remained almost vertical. A vortex or circular eddy developed in the surface flow during high water and sediment was removed from the hole and deposited between the hole and the bank. The movement of water and sediment in a model hole in a flume indicated that a vortex mechanism involving a balance of scour and fill is keeping the hole free of sediment during each period of flood. The sequence of sedimentary structures for the model hole included foreset type beds and dune bedding migrating both upstream and downstream. The final structures preserved de-

pend on the relative lengths of the phases of scour and fill and the maximum mean velocity of the stream. (Knapp-USGS)
W70-06132

ACCUMULATION RATES OF MANGANESE IN PELAGIC SEDIMENTS AND NODULES,
Lamont-Doherty Geological Observatory,
Palisades, N.Y.
M. L. Bender, Teh-Lung Ku, and W. S. Broecker.
Earth and Planetary Science Letters, Vol 8, No 2, p
143-148, April 1970. 6 p, 3 fig, 2 tab, 19 ref.

Descriptors: *Bottom sediments, *Trace elements,
*Manganese, Water chemistry, Geochemistry,
Oceans, Clay minerals, Mineralogy, Deposition
(Sediments).
Identifiers: Manganese nodules.

Accumulation rates of manganese in sediments of 38 deep-sea cores range from 0.1 to 3.4 mg/cc/1000 yr. Manganese accumulation rates in five nodules range from 0.2 to 1.0 mg/cc/1000 yr. In the North Pacific, manganese is apparently incorporated into sediments in association with clay or a related phase; in other ocean basins, no generalizations can be drawn from the data presented. The similarity between nodule and sediment manganese accumulation rates could be coincidence or could reflect the possibility that nodules and sediments accumulate manganese by the same mechanism. (Knapp-USGS)
W70-06138

PRELIMINARY DETERMINATIONS OF SEDIMENT DISCHARGE IN SAN JUAN DRAINAGE BASIN, ORGANCE AND RIVERSIDE COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
Carl G. Kroll, and George Porterfield.
Geological Survey Open-file Report, December 1969. 28 p, 10 fig, 14 tab, 4 ref.

Descriptors: *Sediment load, *Suspended load,
*Bed load, *Urbanization, *California, Sedimentation,
Beaches, Water management (Applied), Surveys,
Data collections, Hydrologic data, Streams,
Streamflow.
Identifiers: San Juan drainage basin (Calif), Orange
County (Calif), Riverside County (Calif).

During the 1967 and 1968 water years the mean daily suspended-sediment discharges at the gaging stations on San Juan Creek and its major tributary, Arroyo Trabuco, near San Juan Capistrano, Calif., were 266 tons and 124 tons, respectively. Extrapolated over the 38 years of water-discharge record 1931-68, the mean daily suspended-sediment discharge at the gaging stations was 124 tons at San Juan Creek and 44 tons at Arroyo Trabuco. The mean daily coarse-sediment discharge for the same 38-year period was about 180 tons at San Juan Creek and 6.1 tons at Arroyo Trabuco. The discharge of coarse sediment at the mouth during the same 38-year period was a mean daily value of 200 tons or 56,000 cubic yards per year. Because of urbanization the mean daily coarse-sediment discharge at the beach will be reduced by about 33 percent during the next 30 years, and, depending upon the water-management practices, the reduction may be even greater. (Knapp-USGS)
W70-06144

PREVENTION OF SCOUR AT BRIDGE ABUTMENTS,
Texas A and M Univ., College Station. Dept. of
Civil Engineering.
For primary bibliographic entry see Field 08A.
W70-06166

PROBLEMS OF STABILITY OF STREAMS IN ERODED BEDS AND STABILITY OF THEIR SHAPES,
Nauchno-Issledovatel'skii Gidroenergeticheskii Institu't, Tiflis (USSR).
N. K. Kereselidze.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B23, p 194-200, 1967. 7 p, 1 fig, 4 ref.

Descriptors: *Stream erosion, *Alluvial channels
*Channel morphology, Dunes, Sand waves, Flow
resistance, Model studies, Hydraulic models,
Stream stabilization, Erosion control, Hydraulics,
Mathematical studies.
Identifiers: Stream stability criteria.

Investigations were carried out to establish criteria of the stability of flows in eroded beds and to determine their flow resistance. The technique applied in these investigations is based on the condition of dynamic stability. Theoretical stability criteria as well as those of the beginning of bed deformation are in good accord with the experimental data. (Knapp-USGS)
W70-06171

THE MEASUREMENT OF TURBULENT VELOCITY FLUCTUATIONS CLOSE TO A BOUNDARY IN OPEN CHANNEL FLOW,
University Coll, London (England). Dept. of Civil Engineering.

For primary bibliographic entry see Field 08B.

W70-06172

STOCHASTIC ANALYSIS OF THE AUTO-FORMATION OF A CHANNEL CUT IN INCOHERENT ALLUVIUM,

Institute for Water Resources, Belgrade (Yugoslavia). Dept. of River Research.
Milorad Miloradov.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B13, p 111-117, 1967. 7 p, 5 fig, 1 ref.

Descriptors: *Erosion, *Channels, *Alluvial channels,
Scour, Stochastic processes, Channel
morphology, Statistical models, Probability,
Stream erosion.

Identifiers: Morava River (Yugoslavia).

When cutting a river meander, it is common practice to excavate a narrow channel and leave it to develop by action of the flowing water. The erosion of such a channel can be considered as a stochastic process, the channel cross-section being a random function of time and position. Hence, the theory of one-dimensional monotonic non-decreasing random processes, as developed by P. Todorovic, could be used to describe the probability distribution functions of channel cross-sections evolving in time. Together with the time coordinate, two parameters enter into the probability distribution function, which depend on the flow conditions and can be determined by experimental methods. An example is given referring to the Morava River in Yugoslavia. (Knapp-USGS)
W70-06175

AREAL VARIATIONS OF BED-FORM CHARACTERISTICS IN MEANDERING STREAMS,

Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 02E.

W70-06176

ACOUSTIC DETECTION OF SEDIMENT MOVEMENT.,

Newcastle-upon-Tyne Univ. (England).

P. Johnson, and T. C. Muir.

Journal of Hydraulic Research, Vol. 7, No. 4, p.
519-540, 1969. 22 p, 9 fig, 12 ref, append.

Descriptors: Acoustic equipment, Sedimentation,
*Sediment discharge, *Sediment load, *Sediment
transport, *Bed load, Foreign research, Sonic
transport.

waves, *Detection, *Noise, Laboratory tests,
Microphones, Test procedures, Streambeds,
Hydrology, Theory.

Identifiers: *Acoustic method, *Bedload movement,
*Bedload noise detectors, Sonic device,
Sonic pickups, Testing equipment, Great Britain.

Laboratory experiments to investigate the relationship between bedload discharge and the intensity and frequency of sound produced by interparticle collision during sediment movement are described. A corresponding theoretical relationship is also derived. For a single size of particle, the frequency of interparticle collision sound extends over a wide spectrum. Bedload discharge in a laboratory channel is estimable from the microphone signal to within plus or minus 35% at a 65% confidence level. Limited field experience indicates that difficulties would be experienced with mixtures of sizes and extraneous noise in rivers. (USBR)
W70-06241

2K. Chemical Processes

THE RELATIONSHIP BETWEEN ENVIRONMENT AND SEDIMENT COMPOSITION (GEOCHEMISTRY AND PETROLOGY) IN THE BIMINI LAGOON, BAHAMAS,
Sheffield Univ. (England). Dept. of Geology.
For primary bibliographic entry see Field 02L.
W70-05913

COLOR OF WATER IN FLORIDA STREAMS AND CANALS,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 07C.
W70-05931

THE CHEMICAL NATURE OF THE ORGANIC MATRIX BELIEVED TO LIMIT WATER PENETRATION IN GRANITIC SOILS,
Nevada Bureau of Mines, Reno. Desert Research Inst.
For primary bibliographic entry see Field 02G.
W70-05957

CHEMICAL INTERACTIONS OF WASTE WATER IN A SOIL ENVIRONMENT,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05C.
W70-06052

A MULTIPLE REGRESSION TECHNIQUE FOR ADJUSTING BACKGROUND VALUES IN STREAM SEDIMENT GEOCHEMISTRY,
Pennsylvania State Univ., University Park. Mineral Conservation Section; and Pennsylvania State Univ., University Park. Dept. of Geochemistry and Mineralogy.
Arthur W. Rose, Eric C. Dahlberg, and M. L. Keith.

Economic Geology, Vol 65, No 2, p 156-165,
March-April 1970. 10 p, 4 fig, 3 tab, 17 ref.

Descriptors: *Sediment load, *Water chemistry,
*Geochemistry, *Regression analysis, Iron, Trace
elements, Manganese, Statistical methods,
Provenance, Geology, Pennsylvania, Exploration,
Mineralogy, Sampling.
Identifiers: Stream sediment chemistry, Multiple
regression, Geochemistry prospecting.

For efficient use of the stream sediment geochemical method in mineral exploration, the reduction of geological and geochemical background 'noise' is desirable, especially for detecting weak anomalies. A multiple regression method for quantifying the effects of differing lithologies in the drainage basin of the sediment and the content of adsorbing iron and manganese oxides in the sediment is described and applied to a survey of 7,500 sq miles in Pennsylvania. The effects of lithology are defined

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as the percentage of the area in the drainage basin occupied by each rock type. The total Fe and Mn content is used to estimate Fe and Mn oxide content. Regression equations expressing Zn, Cu, Ni, Co, Cr and V as a function of these factors account for 20 to 70% of the total variance of each element. Iron content is responsible for a large proportion of the variation explained and appears to be a very important parameter in stream sediments. Comparison of the observed values with the predicted values from the regression equation results in a group of anomalous values that appears to be more useful in mineral exploration than a similar group defined simply as values above some arbitrary or averaged background level. (Knapp-USGS)

W70-06124

ROLE OF GRAVITY, TEMPERATURE GRADIENTS, AND ION-EXCHANGE MEDIA IN FORMATION OF FOSSIL BRINES.

Woods Hole Oceanographic Institution, Mass., and Geological Survey, Woods Hole, Mass.
P. C. Mangelsdorf, Jr., F. I. Manheim, and J.M.T.M. Gieskes.
American Association of Petroleum Geologists Bulletin, Vol 54, No 4, p 617-626, April 1970. 10 p, 2 fig, 5 tab, 46 ref.

Descriptors: *Water chemistry, *Groundwater, *Connate water, *Brines, *Ion exchange, Membrane processes, Clay minerals, Mathematical studies, Mathematical models, Geochemistry, Ions, Sediments, Temperature, Gravity, Chromatography, Ion transport.
Identifiers: Brine formation (Geochemistry).

Calculations show that gravitational settling of ions in an isothermal sediment column could produce increases of equilibrium concentrations in pore waters ranging from 1 percent per 100 m depth for chloride to 4 percent per 100 m depth for strontium. The migration of ions in a thermal gradient (Soret effect) would cause minor salt enrichment upward toward the colder pole, but the presence of cation-exchanging particles such as clays would reverse this tendency and cause pumping of salt downward. A model calculation using literature data for the thermal potentials suggests that about 5-percent enrichment in Cl per 100 m depth may occur under steady-state conditions. These mechanisms do not explain the greater enrichments commonly found in subsurface brines, but may modify salt distributions due to other phenomena. (Knapp-USGS)

W70-06126

THE INFLUENCE OF HENRY'S LAW ON BICARBONATE EQUILIBRIA,

California Univ., Berkeley, Dept. of Hydraulic Engineering; and California Univ., Berkeley, Dept. of Sanitary Engineering.
Jerome F. Thomas, and R. Rhodes Trussell.
Journal American Water Works Association, Vol 62, No 3, p 185-187, March 1970. 3 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Water chemistry, *Carbon dioxide, *Equilibrium, *Bicarbonates, Aqueous solutions, Hydrogen ion concentration, Evaporation, Diffusion, Alkalinity.

Identifiers: Bicarbonate equilibrium, Henry's law.

In a closed system, water saturated with sodium bicarbonate maintains a constant pH. But when the water contacts carbon dioxide in air, pH rises. It is possible to determine the ultimate pH of a water when it comes to equilibrium of the carbon dioxide in the atmosphere. The rate controlling steps are the dehydration of carbon dioxide and the diffusion of carbon dioxide out of the aqueous phase. Based on a consideration of Henry's Law, the equilibrium pH of a bicarbonate solution in equilibrium with air concentrations above 50 ppm will increase from an initial value of 8.3 to some higher value consistent with the total alkalinity. (Knapp-USGS)

W70-06133

THE SOLUBILITY OF FERROUS IRON IN CARBONATE-BEARING WATERS,

Notre Dame Univ., South Bend, Ind. Dept. of Civil Engineering; and Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
Philip C. Singer, and Werner Stumm.

Journal American Water Works Association, Vol 62, No 3, p 198-202, March 1970. 5 p, 8 fig, 2 tab, 16 ref, append.

Descriptors: *Water chemistry, *Iron compounds, *Solubility, *Groundwater, *Bicarbonates, Oxides, Equilibrium, Hydrogen ion concentration, Carbonates, Chemical precipitation, Aqueous solutions.

Under reducing conditions in natural waters, as in the bottoms of lakes under conditions of stagnation and in most groundwaters, the stable form of iron is ferrous iron in the + II oxidation state. In waters free of dissolved carbon dioxide, the solubility of Fe (II) is controlled by solid ferrous hydroxide. At pH values below 10.5, ferrous carbonate controls the concentration of Fe (II) in solution. The solubility product of synthetically prepared siderite (porous carbonate) was determined. At 25 deg C and zero ionic strength, $pK = 10.24$. Groundwaters may be in or near saturation equilibrium with siderite. Bicarbonate and carbonate complexes of Fe (I) are not relevant in most groundwaters; the only species of any significance in carbonate-bearing waters is free ferrous ion. (Knapp-USGS)

W70-06134

ADSORPTION OF COPPER BY CLAY MINERALS, HUMIC ACID AND BOTTOM MUDS,

Rutgers - The State Univ., New Brunswick, N.J. Dept. of Aquatic Weed Control.
D. N. Riemer, and S. J. Toth.
Journal American Water Works Association, Vol 62, No 3, p 195-197, March 1970. 3 p, 5 tab, 3 ref.

Descriptors: *Adsorption, *Copper compounds, *Clay minerals, *Humic acids, *Bottom sediments, Algicides, Copper sulfate, Limestones, Water chemistry, Mud, Clays, Ponds.
Identifiers: Copper adsorption.

The adsorption of Cu from solution by H-Al forms of kaolinite, illite, montmorillonite and humic acid was studied in the laboratory. The adsorption and release of Cu from three pond sediments were also examined. All of the clay minerals and humic acid used completely adsorbed the small amounts of Cu that are normally used to control algae. Based on the absolute amounts of Cu adsorbed, the clay minerals and humic acid could be arranged in the following descending order: humic acid, montmorillonite, illite, kaolinite. Copper sulfate applications to ponds are fixed by the bottom, and the factors controlling the fixation are nature of clay minerals, clay content, organic matter content and, in cases of calcareous bottoms, the percentage of limestone present. (Knapp-USGS)

W70-06135

ACCUMULATION RATES OF MANGANESE IN PELAGIC SEDIMENTS AND NODULES,

Lamont-Doherty Geological Observatory, Palisades, N.Y.

For primary bibliographic entry see Field 02J.

W70-06138

BORON CONTENTS OF SERPENTINITES AND METABASALTS IN THE OCEANIC CRUST: IMPLICATIONS FOR THE BORON CYCLE IN THE OCEANS,

Woods Hole Oceanographic Institution, Mass.; and Smithsonian Institution, Washington, D.C.
Geoffrey Thompson, and William G. Melson.
Earth and Planetary Science Letters, Vol 8, No 1, p 61-65, March 1970. 5 p, 1 fig, 3 tab, 29 ref. AEC Contract AT (30-1)-2174.

Descriptors: *Water chemistry, *Weathering, *Sea water, *Metamorphic rocks, *Boron, Igneous

rocks, Basalts, Clay minerals, Magmatic water, Geochemistry.

Identifiers: Boron cycle (Sea water).

Serpentization of periodotite rocks in the oceanic crust is accompanied by boron enrichment. Hydrothermally altered basalts in the oceanic crust show no comparable increase in boron. In high-temperature reactions of basaltic rocks and seawater, boron is preferentially partitioned into the liquid phase; basaltic rocks exposed on the ocean floor undergo low-temperature weathering by seawater resulting in the addition of boron. Juvenile boron-containing solutions may be responsible for serpentization. Such solutions may also be important in maintaining the boron concentration of the oceans, since boron is removed from seawater both by clay minerals entering the oceans and by alteration of submarine igneous rocks. (Knapp-USGS)

W70-06140

A SUMMARY OF MINERAL AND THERMAL WATERS IN AUSTRALIA,

Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

For primary bibliographic entry see Field 02F.

W70-06145

THE MINERAL AND THERMAL WATERS OF THE TERRITORY OF PAPUA AND NEW GUINEA,

Bureau of Mineral Resources, Geology, and Geophysics, Canberra (Australia).

For primary bibliographic entry see Field 02F.

W70-06151

SPRINGS OF DEEP SEALED ORIGIN IN TANZANIA,

For primary bibliographic entry see Field 02F.

W70-06152

CARBON DIOXIDE, CARBONIC ACID, AND BICARBONATE ION: PHYSICAL PROPERTIES AND KINETICS OF INTERCONVERSION,

Harvard Univ., Cambridge, Mass.

John T. Edsall.

National Aeronautics and Space Administration Report SP-188, Proceedings of Symposium at Haverford College, Pennsylvania, August 20-21, 1968, p 15-27, 1969. 13 p, 2 fig, 8 tab, 36 ref.

Descriptors: *Carbon dioxide, *Aqueous solutions, *Carbonates, *Bicarbonates, *Water chemistry, Chemical reactions, Ions, Solubility, Thermodynamics.

Identifiers: Carbonic acid, Chemical kinetics.

The structure and certain properties of carbon dioxide, carbonic acid, and the bicarbonate ion are reviewed. The topics discussed include the solubility of carbon dioxide in water and in several other polar and nonpolar solvents and a comparison with other simple molecules, the thermodynamics of the hydration of bicarbonate ion or carbonic acid, and the catalysis of the hydration and dehydration reactions by various inorganic and organic molecules and ions, including copper chelate complexes of peptides and related compounds. Certain unexplained discrepancies among the existing data are pointed out, with particular reference to the true ionization constant of carbonic acid and the rate constants for the hydration and dehydration reactions at various temperatures. (Knapp-USGS)

W70-06153

GEOCHEMISTRY OF SOME TERTIARY AND CRETACEOUS AGE OIL-BEARING FORMATION WATERS,

Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.

A. Gene Collins.

Environmental Science and Technology, Vol 1, No 9, p 725-730, September 1967. 6 p, 2 fig, 7 tab, 21 ref.

Descriptors: *Geochemistry, *Brines, *Oil fields, *Mississippi, *Alabama, Hydrogeology, Aqueous solutions, Saline water, Correlation analysis, Chlorides, Ions, Trace elements, Provenance. Identifiers: Oil field brines, Factor analysis.

The relationships of ions dissolved in some oil-bearing Mississippi and Alabama formation waters, the relationships to their environment, and their origin were studied. The waters were analyzed by methods developed by the Bureau of Mines. Sodium, calcium, magnesium, chloride, bromide, iodide, bicarbonate, and sulfate ions were analyzed. The age of water-bearing rock, the association of all samples with petroleum, and the depth of water-bearing rock were known environmental conditions. Correlations were found for several ions and for some ions and their environment. The bromide ion provided a means to distinguish the Tertiary age waters (low bromide concentration) from the Cretaceous age waters (relatively high bromide concentration). (Knapp-USGS) W70-06178

SOME COMMENTS ON 'INTEGRATIVE' AND 'SPECIFIC' PROPERTIES OF THE AQUATIC ENVIRONMENT,

Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Centre de Recherches Hydrobiologiques.

B. H. Dussart.

Chemical Environment in the Aquatic Habitat, Golterman, H L and Clymo, R S, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, p 24-19, 1967. 3 ref.

Descriptors: *Chemical analyses, *Water chemistry, *Aqueous environments, Limnology, Hydrogen ion concentration, Oxidation-reduction potential, Alkalinity, Analytical techniques, Dissolved oxygen, Density, Conductivity, Environmental factors, Carbonates, Carbon dioxide, Bicarbonates, Photosynthesis, Humic acids, Iron compounds, Hydrogen sulfide, Anions, Cations, Polarographic analysis, Chemical oxygen demand, Equilibrium, Phosphorus compounds.

Identifiers: *Integrative properties, *Specific properties, *Data acquisition, *Data interpretation, Dry residue, Biotic factors, Abiotic factors, Ionic balances, Buffering, Alkaline reserves, Winkler method, Global methods.

Based upon the type of environmental information which they yield, hydrochemical analyses can be classified as integrative (designated by the untranslatable French term, 'global') or as specific. Global properties are influenced by diverse factors, and require for correct interpretation at least partial knowledge of those factors. Global analyses include pH, redox potential (rH), alkalinity, oxygen, chemical oxygen demand (COD), density, dry residue, and electrical conductivity. Factors influencing pH, rH, alkalinity, oxygen, and COD are considered here in some detail. Specific or special methods, which may consider only a single element, provide exact information regarding environmental composition and may even make possible the establishment of ionic balances, but do not provide information bearing on dynamic characteristics of the chemical species in the environment. Since, as is well known for iron and phosphorus, not all molecular forms of an element take part in all biological or chemical processes, an aim of limnological research should be to distinguish between possible pathways. Ecologically considered, the two sorts of methods must be chosen well and used in a complementary fashion to provide better understanding of interrelationships between the biotic and abiotic worlds as they function in time. (See W70-04821) (Eichhorn-Wisconsin) W70-06216

AUTOMATED ANALYSIS FOR NITRATE BY HYDRAZINE REDUCTION,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Engineering Section. For primary bibliographic entry see Field 05A. W70-06219

THERMODYNAMICS OF BIOLOGICAL SYNTHESIS AND GROWTH,
Stanford Univ., Calif. Dept. of Civil Engineering. For primary bibliographic entry see Field 05C. W70-06234

THE PHOTOSYNTHETIC PIGMENTS OF LAKE SUPERIOR PERIPHYTON AND THEIR RELATION TO PRIMARY PRODUCTIVITY,

Minnesota Univ., Minneapolis. Water Resources Research Center.

Lee W. Stokes, Theodore A. Olson, and Theron O. Odlaug.

Available from the Clearinghouse as BP-191 523, \$3 in paper copy, 65 cents in microfiche. University of Minnesota Graduate School, Water Resources Research Center, Minneapolis, WRRC Bulletin 18, January 1970. 150 p. 110 fig, 26 tab, 168 ref. 3 plates, 2 appendices. OWRR A011-MINN (9).

Descriptors: *Lake Superior, *Eutrophication, *Periphyton, Photosynthesis, Pigments, Primary productivity, Light intensity, Chlorophyll, Respiration.

Identifiers: Shade tolerance, Light adaptation, Epilithic periphyton.

The biomass, community structure, and photosynthetic activity of epilithic periphyton of the north shore of Lake Superior were investigated during the summers of 1966, 1967, and 1968. Pigment ratios indicated predominance of Chrysophyta. The standing crop on oven-dry basis was 156 gram/square meter. Net production in 1967 averaged 1.01 gram carbon fixed per square meter/day. Daily increment of chlorophyll was 0.57 milligram/square meter. Up to 40 foot depth, periphyton can be 5 to 6 times as important in primary production as the phytoplankton. Q-sub-10 for conditioned samples at light saturation ranged from 1.24 to 2.48. The compensation point varied from 80 to 130 foot-candles. The efficiency of energy utilization by periphyton was 0.82, a value typical for algal communities. It is assumed that periphyton will provide a baseline for estimating the advance of eutrophication of Lake Superior. (Wilde-Wisconsin) W70-06238

2L. Estuaries

THE RELATIONSHIP BETWEEN ENVIRONMENT AND SEDIMENT COMPOSITION (GEOCHEMISTRY AND PETROLOGY) IN THE BIMINI LAGOON, BAHAMAS,

Sheffield Univ. (England). Dept. of Geology.

Roger Till.

Journal of Sedimentary Petrology, Vol 40, No 1, p 367-385, March 1970. 19 p, 5 fig, 10 tab, 23 ref.

Descriptors: *Geochemistry, *Mineralogy, *Lagoons, *Islands, *Reefs, Deposition (Sediments), Chemical precipitation, Chemical analysis, Water chemistry, Statistical methods, Correlation analysis, Sedimentology.

Identifiers: *Bimini.

Surface sediments from the Bimini Lagoon were analyzed for their major element content (CaO, SrO and MgO), minor element content (Si, Al, Fe, Ba, Cr and Mn), mineralogy (aragonite, high and low magnesium calcite) and petrographic constituents (grain size, intraclasts, pellets, oolites, skeletal material and mud content). The overlying waters were also analyzed. The data were analyzed statistically to discover controls on overall geochemical variation. Linear product moment correlation coefficients were calculated for all variable pairs. A correlation matrix was generated and used to identify covarying groups of variables. The physical environment in terms of water quietness (rather than the chemical environment) is shown to govern the organic and inorganic phase constituents of the sediments; these in turn govern the bulk chemistry. Correlation analysis was repeated for the sample population from each of the three water masses in the lagoon. The same basic control

of water quietness is operative in each area. A simple analysis of variance for the sample groups from each water mass showed that the sediments from three areas of different salinity in the lagoon are also significantly different in bulk constitution. But the salinity (and hence chemistry) of the waters is not simply related to the sediment composition; for the three masses are also distinct in terms of physical environment and it is this which is reflected in the mean sediment composition. (Knapp-USGS) W70-05913

STUDY OF ESTUARINE POLLUTANT AND WATER QUALITY DISTRIBUTION IN THE NEW YORK CITY -- NEW JERSEY METROPOLITAN AREA.

Quirk, Lawler and Matusky, New York.

For primary bibliographic entry see Field 05B. W70-05937

TEMPERATURE, SALINITY, AND TRANSPARENCY OBSERVATIONS, COASTAL GULF OF MAINE, 1962-65,

Bureau of Commercial Fisheries, West Boothbay Harbor, Maine. Biological Lab.

Joseph J. Graham.

Available from the Clearinghouse as PB-189 119, \$3.00 in paper copy, \$0.65 in microfiche. U.S. Fish and Wildlife Service Data Report no. 42, Wash, DC, Jan 70. 45 p.

Descriptors: *Coasts, Marine fisheries, Environmental effects, *Herrings.

Identifiers: Clupea harengus harengus Linnaeus.

Staff members of the Bureau of Commercial Fisheries Biological Laboratory, Boothbay Harbor, Maine, measured water temperature, salinity, and transparency to study the environment of immature herring (*Clupea harengus harengus* Linnaeus) in the coastal Gulf of Maine from 1962 through 1965. The observations were plotted for 11 cruises. Temperature usually increased and salinity decreased from east to west along the coast. These trends were complicated vertically by less tidal mixing and larger river discharges in the west, causing there a more pronounced vertical stratification than in the east. Transparency usually increased from inshore to offshore, and at times the distribution of the transparency isolines agreed closely with those for temperature. (W70-05963)

SHORE EROSION BY STORM WAVES,

Corps of Engineers, Washington, D.C. Beach Erosion Board.

Joseph M. Caldwell.

Available from the Clearinghouse as AD-699 407, \$3.00 in paper copy, \$0.65 in microfiche. Miscellaneous paper No 1-59, April 1959. 19 p, 8 figs.

Descriptors: *Beach erosion, *Waves (Water), *Storms, Hurricanes, Stabilization, Control, *Dunes, Beaches.

In connection with its mission of developing hurricane protection plans for the Atlantic and Gulf shores of the United States, the Corps of Engineers, Department of the Army, has need to know the magnitude of shore erosion which can be expected from hurricane wave attack. To partially fill this need, the information on storm wave erosion available in the files of the Beach Erosion Board is summarized in this report. (W70-05965)

WAVE FORCES ON PILES: A DIFFRACTION THEORY,

Corps of Engineers, Washington, D.C. Beach Erosion Board.

R. C. MacCamy, and R. A. Fuchs.

Available from the Clearinghouse as PB-116 606, \$3.00 in paper copy, \$0.65 in microfiche. Technical memorandum No 69, Dec 1954. 21 p, 2 tabs, 5 refs.

Field 02—WATER CYCLE

Group 2L—Estuaries

Descriptors: *Beach erosion, *Waves (Water), *Piles (Foundations), *Pile foundations, Harbors, Shore protection, Coastal structures.

Although circular piling is a much-used structural element in shore protection, harbor, and other maritime structures, only recently have significant advances been made toward gaining a quantitative understanding of the forces developed by wave action against piling. The present report deals with this subject.

W70-05967

REPORT ON BEACH STUDY IN THE VICINITY OF MUGU LAGOON, CALIFORNIA, Corps of Engineers, Washington, D.C. Beach Erosion Board.

D. L. Inman.

Available from the Clearinghouse as AD-699 392, \$3 in paper copy, 65 cents in microfiche. Technical Memorandum No 14, Mar. 1950, 52 p., 27 figs.

Descriptors: Beach erosion, Waves (Water), Ocean waves, Stabilization, Tides, Topography, California.

Identifiers: Mugu Lagoon (Calif.).

Investigation and study indicate that the beaches and sand spits bordering Mugu Lagoon are not stable, and that improvements in this area should be undertaken with caution. Any changes will tend to upset the natural beach equilibrium and in some cases may result in further depletion and erosion of the narrow spits bordering the lagoon. Longshore current studies showed that the complex bottom topography over the Mugu Submarine canyon heads gives rise to currents that may be opposed in direction to the currents along the straight beach northwest of Mugu. The angle of wave approach and the 'piling up' of water at wave convergence points appear to be the controlling factors in determining the direction of flow of the longshore currents. The effect of (1) spring tides, (2) high waves, and (3) direction of the longshore transport of sand on the stability of the spits bordering Mugu Lagoon is discussed.

W70-05969

HURRICANE SURGE PREDICTIONS FOR CHESAPEAKE BAY,

Corps of Engineers, Washington, D.C. Beach Erosion Board.

Charles L. Bretschneider.

Available from the Clearinghouse as AD-699 408, \$3 in paper copy, 65 cents in microfiche. Miscellaneous Paper No 3-59, Sept. 1959, 59 p, 19 refs, 7 tabs, 20 figs.

Descriptors: *Beach erosion, *Waves (Water), Beaches, *Hurricanes, *Surges, Tides, Ocean waves, Forecasting, Design, Mathematical models. Identifiers: *Chesapeake Bay.

The report presents a comprehensive investigation of hurricane surge problems for the Chesapeake Bay area. Methods and techniques are presented, and are calibrated with available surge data, so that the computational procedures result in reasonable estimates of maximum hurricane surge for design purposes. It is believed that the final results given in this report can only be refined by use of additional hurricane surge data, suitable for furthering the present investigation. Such additional hurricane surge data are not available at present, but might become available from future hurricanes affecting the Chesapeake Bay area. In addition theoretical studies, the formulas and techniques of which must also be calibrated, performed in the future, might tend to refine the surge results presented in this report.

W70-05970

THE SOURCE, TRANSPORTATION, AND DEPOSITION OF BEACH SEDIMENT IN SOUTHERN CALIFORNIA,

Corps of Engineers, Washington, D.C. Beach Erosion Board.

John W. Hardin.

Available from the Clearinghouse as PB-103 919, \$3 in paper copy, 65 cents in microfiche. Technical Memorandum No 22, Mar. 1951, 129 p.

Descriptors: *Beach erosion, *Beaches, *Sands, *Sediment transport, Waves (Water), Ocean waves, California.

Beach studies are of importance as a basis for engineering design of harbors, shore protective works, and other commercial and recreational facilities. Geologists find modern beaches to be of particular interest as sources of information about sedimentary processes and as clues to the origin of certain ancient deposits. This thesis is the result of work undertaken for the Los Angeles District Engineer Office and of graduate work at the University of California, Los Angeles. It deals with the source, transportation, and deposition of beach sands along the southern California coast from Carpinteria to Point Fermin.

W70-05971

HURRICANE SURGE PREDICTIONS FOR DELAWARE BAY AND RIVER,

Corps of Engineers, Washington, D.C. Beach Erosion Board.

Charles L. Bretschneider.

Available from the Clearinghouse as AD-699 904, \$3 in paper copy, 65 cents in microfiche. Miscellaneous paper No 4-59, Nov. 1959, 53 p, 17 refs, 4 tabs, 21 figs.

Descriptors: *Beach erosion, *Waves (Water), Beaches, *Hurricanes, *Surges, Tides, *Ocean waves, Breakwaters, Mathematical models, Design, Delaware river, Forecasting.

Identifiers: Delaware River.

Surge heights have been computed for various locations for Delaware Bay and River for two hypothetical hurricanes. Hurricane 'A' is the same as the September 14, 1944, Cape Hatteras hurricane transposed to the Delaware Bay area to produce maximum surge entering that bay and propagating to various points of interest (See HUR 7-20). Hurricane 'B' is exactly the same in all respects as hurricane 'A' except that all wind speeds are greater by 5 mph. The stress parameter used was $k=3.0 \times 0.000001$. A table summarizes computed surge elevations.

W70-05973

BACTERIAL POPULATION DENSITIES (HETEROTROPHS) IN THE WATER COLUMN OF THE SOUTHERN AND INDIAN OCEANS,

Akademija Nauk SSSR, Moscow. Institut Mikrobiologii.

A. E. Kriss, I. E. Mishustina, and M. N. Lebedeva. Microbiology, Vol 38, No 3, p 430-435, 1969. 3 fig, 2 tab, 10 ref.

Descriptors: *Bacteria, *Population, *Density, *Columns, *Water, *Oceans, Indian Ocean, Microorganisms, Stratification, Tropical regions, Latitudinal studies, Yeasts, Arctic Ocean, Pacific Ocean, Sampling.

Identifiers: *Heterotrophs, *Southern Ocean, Fremantle (Australia), Mirny (Antarctica), Africa, Prydz Bay (Antarctica), Ganges estuary (Pakistan), Drake's Bay (Antarctica), Sunda, Philippines, Coral Sea, Bacterium agile, Kamchatka (USSR), Kurile Island (USSR), Gulf of Bengal (India).

Microflora of the Southern Ocean from Fremantle, Australia, to Mirny, Antarctica; from Antarctica to Africa along 20 degrees east longitude; in Prydz Bay, Antarctica, and in Indian Oceans's western equatorial zone was studied. Bacteria in the water column fluctuated from zero to tens, and occasional readings showed hundreds of bacteria per 50 milliliters of water. In western Indian sector (Southern Ocean) bacterial population density was less than in eastern and the equatorial zone population exceeded that in high latitudes. In the section from Australia to Antarctica, microbiological tracing detected four water layers of equatorial-tropi-

cal origin below ocean surface. A layer of Antarctic origin was widest from Antarctica to 50 degrees south latitude. Influence of Antarctic water was sharper from Antarctica to Africa along 20 degrees east longitude, filling nearly the entire ocean column south of 55 degrees south latitude. Waters of equatorial-tropical origin were found here only as isolated islands. In sections from Australia to Antarctica and Antarctica to Africa, the water layer topography of equatorial-tropical origin was consistent. Considerable similarity appeared in the Southern Ocean hydrological structure from Australia to Mirny and in corresponding parts from Mirny to Ganges estuary. (Jones-Wisconsin) W70-05985

ON THE NUTRITION AND METABOLISM OF ZOOPLANKTON. I. PRELIMINARY OBSERVATIONS ON THE FEEDING OF THE MARINE COPEPOD, CALANUS HELGOLANDICUS (CLAUS),

Marine Biological Association of the United Kingdom, Plymouth (England). Lab.

E. D. S. Corner.

Journal of the Marine Biological Association of the United Kingdom, Vol 41, p 5-16, 1961. 1 tab, 36 ref.

Descriptors: *Nutrient requirements, *Metabolism, *Zooplankton, *Marine animals, *Copepods, Light intensity, Sea water, Organic matter, Lipids, Proteins, Carbohydrates, Respiration, Temperature, Food chains, Phytoplankton, Diatoms, Chlamydomonas, Flow rates, Oxygen requirements.

Identifiers: *Calanus helgolandicus (Claus), Calanus finmarchicus (Gunnerus), Flagellates, Assimilation, Ditylum brightwellii, Chlamydomonas, Particulate matter, Plymouth Sound (England), Dark, Dunaliella, Skeletonema, Uptake, Filtering rate.

Measurements were made of the quantity and type of food assimilated by adult female marine copepod Calanus helgolandicus (Claus) during the summer months. Animals kept in the drak at 10C under a continuous flow of 'outside' Plymouth sea water (0.95 to 2.50 milligrams insoluble organic material/liter) removed 26.0 to 66.5 micrograms/day per Calanus, 74 to 91% actually digested. Volumes of sea water filtered daily varied between 10.0 and 36.0 milliliters/animal, averaging 21.5. Animals preferentially selected a diet high in organic content from the particulate food available, digesting average daily quantities of 18.1 micrograms carbohydrate, 6.5 micrograms lipid, and 2.7 micrograms protein. Average amount of food digested daily accounted for 25.3% of dry weight and was equivalent to an average respiration rate of 26.5 microliters oxygen/animal per day, which adequately accounts for the highest values reported by others for C finmarchicus (Gunnerus) kept under similar conditions of light and temperature. These results, providing direct evidence that Calanus obtains the bulk of its food from particulate material present in the sea, are discussed with special reference to Putter's hypothesis. (Jones-Wisconsin) W70-05997

MARINE BENTHIC DIVERSITY: A COMPARATIVE STUDY,

Woods Hole Oceanographic Institution, Mass.

Howard L. Sanders.

The American Naturalist, Vol 102, No 925, p 243-282, 1968. 18 fig, 3 tab, 44 ref.

Descriptors: *Benthos, *Marine animals, Ecological distribution, Sampling, Methodology, Oceans, Latitudinal studies, Depth, Temperature, Salinity, Stability, History, Estuarine environment, Indian Ocean, Continental shelf, Continental slope, New England, Methodology, Physiological ecology, Biological communities, Geologic time, Mathematical models.

Identifiers: *Diversity measurements, *Composition, Abyssal rise, Rarefaction method, Polychaete-bivalve fraction, Lake Baikal (Siberia), Stability-

Saline Water Conversion—Group 3A

time hypothesis, Tropical shallow waters, Deep sea waters, Outer continental shelf, Boreal shallow water, Tropical estuary, Boreal estuary.

Methodology is presented for measuring marine benthic diversity based on rarefaction of actual samples. Application of this technique enables a within-habitat analysis of the bivalve and polychaete components of soft-bottom marine faunas differing in latitude, depth, temperature, and salinity. The resulting diversity values were rigidly correlated with the physical stability and past history of these environments. A stability-time hypothesis was invoked to fit these findings, and, with this hypothesis, predictions made diversities present in certain other environments as yet unstudied. The time component of stability-time hypothesis is best illustrated with lakes; Lake Baikal (Siberia), formed either about 1 or 30 million years ago, is characterized by a highly diverse fauna. The two types of diversity, based on numerical percentage composition and on specie numbers, were compared and shown to be poorly correlated. Data indicated species number is the more valid diversity measurement. The rarefaction methodology was compared with a number of diversity indices using identical data; many of these indices were markedly influenced by sample size. Good agreement was found between the rarefaction methodology and the Shannon-Wiener information function. (Jones-Wisconsin)

W70-05998

EFFECTS OF SURFACE RUNOFF AND WASTE DISCHARGE INTO THE SOUTHERN SECTOR OF KANOEHE BAY: JANUARY-APRIL 1968,
Hawaii Univ., Honolulu. Water Resources Research Center.

For primary bibliographic entry see Field 05C.

W70-06099

SEDIMENTARY ENVIRONMENT AND SEDIMENTS OF COOK INLET, ALASKA,
Alaska Univ., College. Inst. of Marine Science.
G. D. Sharma, and D. C. Burrell.

American Association of Petroleum Geologists Bulletin, Vol 54, No 4, p 647-654, April 1970. 8 p, 5 fig, 1 tab, 8 ref.

Descriptors: *Sediments, *Sediment transport, *Inlets (Waterways), *Alaska, Sedimentary structures, Deposition (Sediments), Tides, Tidal effects, Currents (Water), Estuaries, Erosion, Scour, Bed load, Suspended load, Turbulence, Ice, Glaciers, Topography.
Identifiers: Cook Inlet (Alaska).

The distinctive sedimentary environment of Cook Inlet, south-central Alaska, may be attributable in part to a unique combination of the gross morphologic and climatologic characteristics of the area. The sediments consist predominantly of cobbles, pebbles, and sand with minor admixtures of silt- and clay-size material. Three sedimentary facies are suggested on the basis of the detailed grain-size distributions. The boundaries of each facies are very well defined. During the summer months, large quantities of glacially derived sediment are added to the upper reaches of the inlet. Strong currents prevent early deposition of most of the silt and clay which are transported seaward toward the Forelands morphologic constriction. In this area intense tidal flushing removes almost all material of less than gravel size. The rate of sediment supply to the inlet is minimal during the extended winter season, and sediments are reworked predominantly by ice rafting. Much of the material probably is deposited initially in the area adjacent to the Forelands. (Knapp-USGS)

W70-06129

BORON CONTENTS OF SERPENTINITES AND METABASALTS IN THE OCEANIC CRUST: IMPLICATIONS FOR THE BORON CYCLE IN THE OCEANS,
Woods Hole Oceanographic Institution, Mass.; and Smithsonian Institution, Washington, D.C.

For primary bibliographic entry see Field 02K.
W70-06140

THE GEORGES RIVER HYDRAULIC, HYDROLOGIC AND RECLAMATION STUDIES,

New South Wales Univ., Kingston (Australia).
C. H. Munro, D. N. Foster, R. C. Nelson, and F. C. Bell.

New South Wales University Water Research Laboratory Report No 101, December 1967. 32 p, 32 fig, 20 ref, 4 append.

Descriptors: *Estuaries, *Water resources development, *Land development, *Wetlands, *Flood control, Marshes, Urbanization, Hydrology, Aquatic environment, Multiple-purpose projects, River basin development, Environmental effects, Environmental engineering.
Identifiers: New South Wales (Australia).

Reclamation of inlets along the foreshores of the Georges River Estuary, New South Wales, Australia has been proposed. Hydraulic studies have shown that the proposed works will affect the river regime to some extent. Tidal velocities will be reduced by up to 10 percent leading to siltation of the river channels. A maximum reduction of 10 percent in the cross sectional areas of the river channels is forecast if all the proposed works are carried out. The proposed works will also increase the pollution problem to some extent by reducing the tidal storage available for dilution of contaminants introduced into the river. As the river regime will be upset by reclamation works, it is considered unwise to proceed with large-scale schemes, such as that proposed for Lime Kiln Bay, without first carrying out a study of the ultimate reclamation requirements for the estuary. (Knapp-USGS)

W70-06177

THE SEA, (VOL 2).

Hill, M N, general editor. New York, John Wiley and Sons, 1965. 554 p.

Descriptors: *Oceanography, *Reviews, *Sea water, *Chemical properties, Oceans, Estuaries, Physiological ecology, Radioactivity, Radioisotopes, Mixing, Ocean currents, Chemical analysis, Instrumentation, Fertility, Sampling, Organic compounds, Thermometers, Phytoplankton, Bioassays, Marine fisheries, Geographical regions, Food chains, Biological communities, Submarines, Sea level, Analytical techniques, Measurement.

Identifiers: *Compendia, *Chemical composition, *Comparative oceanography, *Descriptive oceanography, Biological oceanography, Micronutrients, Gyropendulum, Equatorial currents, Eastern boundary currents, Drogues, Floats, Deep currents, Deep seas, Fishery dynamics, Biological species, Water masses, Bathyscaphs, Mooring, Anchoring.

This compendium, the second volume of a treatise on oceanography, constitutes a source of detailed discussions regarding chemical and biological processes occurring in marine environments. Topical coverage, by chapters, of its first section, on chemistry, includes: oceans as a chemical system; influence of organisms on composition of sea-water; artificial radioactivity in sea; radioisotopes and large-scale oceanic mixing; chemical instrumentation; water sampling and thermometers. Second section considers oceanic fertility, covering: productivity, definition and measurement; organic regulation of phytoplankton fertility; bioassay of trace substances. Third section, on currents, comprises: equatorial current systems; eastern boundary currents; the southern ocean; deep-current measurements with neutrally buoyant floats; drogues and neutral buoyant floats; estuaries; applications of gyropendulum. Fourth section, on biological oceanography, includes: geographic variations in productivity; biological species, water masses and currents; communities of organisms; theory of oceanic food-chain relationships; analysis and interpretation of fishery dynamics. Section

five, oceanographic miscellanea, covers: seasonal changes in sea-level; bathyscaphs and deep submersibles in oceanography; deep-sea anchoring and mooring. The volume, which is the product of 29 contributors, contains a preface by the general editor, and author and subject indices. (See also W70-06211) (Eichhorn-Wisconsin)
W70-06210

II. FERTILITY OF THE OCEANS. 7. PRODUCTIVITY, DEFINITION AND MEASUREMENT,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.

E. Steemann Nielsen.

The Sea (Vol 2), M N Hill, general editor, New York, John Wiley and Sons, p 129-164, 1965. 20 fig, 3 tab, 66 ref.

Descriptors: *Productivity, *Measurement, *Sea water, Photosynthesis, Phytoplankton, Transparency, Trophic levels, Standing crop, Water pollution effects, Analytical techniques, Sampling, Atlantic Ocean, Chlorella, Respiration, Chlorophyll, Physiological ecology, Coccilithophores, Diatoms, Dinoflagellates.

Identifiers: *Definitions, Photobiology, Radiocarbon uptake techniques, Light-dark bottle techniques, Nutrient consumption techniques, Oxygen production techniques, Irradiance, Gross primary production, Net primary production, Isotope discrimination, Depth effects, Seasonal effects, Tropical seas, Norwegian Sea, Sargasso Sea, Arctic seas, South China Sea, Iceland, Kattegat.

Marine production is more precisely defined in terms of two narrowly restricted concepts: gross primary production which is rate of real photosynthesis; and net primary production, equalling gross primary production less rate of algal respiration. Production of animal matter represents transfer of matter or energy from one trophic level to another. Concept of standing stock (= standing crop) is not synonymous with production, although it is often a useful index of marine productivity. Primary production may be estimated from consumption of carbon dioxide, from oxygen production in light and dark bottles, and from radiocarbon uptake. In radiocarbon technique, dark fixation of carbon and isotope discrimination constitute potential sources of error for which corrections may be required. Water color and transparency, defined in terms of depth of photosynthetic layer, yield useful estimates of production in areas of open ocean not subject to coastal influences. Significance of single determinations of production vary according to extent of temporal and seasonal variations, and horizontal movement of water masses. Because photosynthesis is inhibited at high light levels, production at sea surface may be less than a maximum occurring deeper, and oscillations of production rate, due to variations in irradiance, tend to be damped out. (See W70-06210) (Eichhorn-Wisconsin)
W70-06211

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

THE ELECTROSORB PROCESS FOR DESALTING WATER,
Marquardt Co., Van Nuys, Calif.

Allan M. Johnson, A. Wayne Venolia, Robert G. Wilbourne, and John Newman.

Report available for sale by Superintendent of Documents, US Government Printing Office, Wash. DC 20402 - Price 40 cents. Office of Saline Water Research and Development Progress Report No 516, March 1970, 31 p, 26 fig, 2 tab, 16 ref. OSW Contract No 14-01-0001-1444.

Descriptors: *Desalination processes, *Ion transport, *Adsorption, *Electrochemistry, Separation

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

techniques, Electrolysis, Electrodialysis, Electrical studies.
Identifiers: Electrosorb desalination.

The theory of potential modulated ion sorption is discussed in terms of a capacitance model. The experimental program is described, and review of the economic feasibility of the method is presented. A theory was developed which is consistent with experimental evidence. Experimental work demonstrated the effectiveness of the system when operating on feedwaters composed of the principal ionic species that are commonly found in natural waters. Preliminary costs studies indicate that reasonable costs can be expected, especially for the improvement of waters of relatively low salinity, provided that adequate durability of the electrodes can be attained. (Knapp-USGS)
W70-06121

DETERMINATION OF THE SURFACE AND COLLOIDAL CONDITIONS WHICH CAN LEAD TO HIGH SALT REJECTION REVERSE OSMOSIS POLYMER MEMBRANES,

Philco-Ford Corp., Newport Beach, Calif.
Wayne J. Subcasky, and Gilbert Segovia.

Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402, Price \$1.25. Office of Saline Water Research and Development Progress Report No 466, October 1969. 135 p, 41 fig, 30 tab, 50 ref. OSW Contract No 14-01-0001-1317.

Descriptors: *Desalination processes, *Reverse osmosis, *Membranes, Membrane processes, Permeability, Plastics, Semipermeable membranes, Laboratory tests.

Identifiers: Membrane evaluation, Salt rejection.

Detailed descriptions are given of the facilities used to prepare both flat sheet and tubular reverse osmosis membranes and to determine their performance characteristics. Correlations are given for the surface tension lowering of characteristic feed solutions and for the reduction in water and salt fluxes through membranes with the concentration of additive in the feed solution. Correlations were found, by means of infrared spectroscopy, between the extent of hydrogen bonding of water to hydrophilic groupings in various additives and the effectiveness of the additives in improving desalination characteristics. Measurements were made of (1) viscosity, turbidity, and optical depolarization parameter of solutions of various concentrations of cellulose acetate in acetone; (2) the viscosity of various solutions of cellulose acetate in acetone-water and acetone-formamide mixtures; and (3) the gravimetric swelling ratio, turbidity, turbidity ratio, and distilled water transport rate of membranes cast from various solutions of cellulose acetate in acetone-water, in acetone-formamide, and acetone-Mg chloride mixtures. Performance parameters were measured for membrane casts from solutions of cellulose acetate in acetone, in dioxane, in acetonitrile, and in dimethylformamide solvents. (Knapp-USGS)
W70-06148

3B. Water Yield Improvement

SWAMPY FORESTS AND BOGS OF SIBERIA, N. I. Plyavchenko.

Portions of this document are not fully legible. Trans. of Zabolochennye Lesa i Bolota Sibiri. Academy of Sciences, Moscow, 1963. Army Foreign Science and Technology Center Technical Translation. FSTC-HT-23-310-70. December 1969, 215 p.

Descriptors: *Tundra, *Swamps, *Bogs, *Succession, Ecology.
Identifiers: *Peat bogs, *Siberia.

The lands of the forest reserves of Siberia and the Far East include over 110 million hectares of swamps and very swampy forest covered lands, the

dendritic vegetation of which is not considered timber. This amounts to about 79% of the entire areas of swamp and swampy lands of the Soviet Union, accounted for by forestry statistics. The present thematic collection includes data almost entirely pertaining to the territory of Siberia. In it examination is made of the specific features of swamp formation, types of swamp and swampy forests in various geographical regions. The results of studies of the structure and growth of the root systems of dendritic plants in swamps of various types are presented; the characteristics of the composition and seasonal dynamics of the soil fauna and microflora are given and the interaction between earth worms and the microflora of swampy forest soils are described. The characteristic of the soil fauna of drained forest soils is given on the basis of investigations performed on the drained units of the Siverskiy Forestry Farm in the Leningradskaya where the drainage reclamation works have a history of more than half a century.
W70-06034

EFFECT OF EROSION - CONTROL LAND TREATMENT ON FLOW FROM AGRICULTURAL WATERSHEDS,

Agricultural Research Service, Washington, D.C. For primary bibliographic entry see Field 02E.
W70-06040

ECOLOGICAL IMPLICATIONS OF RIPARIAN VEGETATION MANAGEMENT,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. C. J. Campbell.

Journal of Soil and Water Conservation, Vol 25, No 2, p 49-52, March-April 1970. 4 p, 3 fig, 17 ref.

Descriptors: *Water yield improvement, *Environmental effects, *Evapotranspiration control, *Clear-cutting, *Forest management, Land management, Runoff, Streamflow, Topography, Vegetation effects, Watershed management, Riparian plants.
Identifiers: Riparian vegetation.

Managing riparian vegetation in the Southwest to increase water yield may require selective clear-cutting rather than complete removal of riparian plants to maintain a biological balance and thus prevent thermal pollution, channel erosion, and destruction of aquatic and wildlife habitats. To properly evaluate costs and benefits, managers must also consider costs of initial vegetation removal plus costs of replacement with other life forms. If in the future we consider water a natural resource most beneficial to cities located many miles downstream, then, as demand increases, prices of water will rise. This, in turn, will justify more sophisticated supply and transport systems. Perhaps then it will be feasible and in fact necessary, to bypass some stream channels completely by piping the water directly from the watershed. (Knapp-USGS)
W70-06103

WEATHER MODIFICATION AS AN UNCERTAIN INNOVATION,

For primary bibliographic entry see Field 06B.
W70-06258

3C. Use of Water of Impaired Quality

RELATIONSHIP OF WATER QUALITY AND SOIL PROPERTIES TO SEEPAGE PROBLEMS,

Seepage Control Inc., Phoenix, Ariz.

J. Harlan Glenn.

Proceedings, Seepage Symposium, Second, March 25-27, 1968, Phoenix, Arizona, U.S. Dept. of Agriculture, Agricultural Research Service ARS 41-147: April 1969, p 1-7, 11 fig, 7 ref.

Descriptors: *Seepage, *Water types, *Linings, *Water quality, *Soil properties, Leakage, Reservoir leakage, Canal seepage, Canal linings, Concrete-lined canals, Canals, Dams, Water works, Water storage, Clays, Soil sealants, Mineralogy, Salinity, Salt balance, Soil tests, Soil compaction, Soil stabilization, Soil structure, Irrigation, Arizona, South Dakota, Water loss.
Identifiers: *Environmental chemistry.

Although permanent linings are used more and more frequently in water works construction, soil linings continue to be used in major operations such as large reservoirs. Unfortunately, rate of actual seepage loss in the field is often 5 to 10 times the amount which laboratory soil tests predicted. One of the primary causes of seepage loss is the effect of water quality on the soil lining. This fact is widely recognized in the irrigated agriculture and petroleum industries, but this knowledge is seldom put to use in water-works design. Water which contains a low ratio of sodium to calcium plus magnesium usually affects any clay soil by increasing its permeability. Thus, if laboratory analysis of soils does not utilize water with the same mineral content as that found in the field, the resulting data are not realistic. Specific examples from Arizona and South Dakota illustrate the problems which may be encountered and the variety of possible solutions that are available. Much more experimentation in the field of environmental chemistry is necessary. (See W70-06010). (Carr-Arizona)
W70-06009

WATER AND POLLUTION CONTROL IN THE IRON AND STEEL INDUSTRY, WITH SPECIAL REFERENCE TO THE SOUTH AFRICAN IRON AND STEEL INDUSTRIAL CORPORATION,

Pretoria Steel Works (South Africa). For primary bibliographic entry see Field 05D.
W70-06088

3D. Conservation in Domestic and Municipal Use

MUNICIPAL CORPORATIONS - GENERAL POWERS (CONTROL OF WATER SUPPLY AND WATERCOURSES).

Ohio Rev Code Ann secs 715.08, 715.15, 715.19, 715.31, 715.32, 715.40, 715.41, 715.47 (Page 1953).

Descriptors: *Ohio, *Cities, *Water supply, *Drainage, Legislation, Municipal water, Waste disposal, Waste water treatment, Water works, Canals, Drains, Ditches, Streams, Docks, Piers, Cost-benefit theory, Bridges, Regulation, Standing waters, Surface waters, Natural flow, Obstruction to flow.
Identifiers: Ferries.

Any municipal corporation may provide for a water supply and water works. Any municipality may construct or improve any canal or watercourse within or contiguous to its boundaries. Public wharves, landings, piers, docks, bridges and viaducts may also be constructed, improved and regulated and the rates for use of such facilities established. Municipalities have exclusive authority over the establishment, regulation and licensing of ferries. They may establish, maintain and regulate sewage works and treatment plants. Municipalities may drain stagnant water from any property within their boundaries, with the owner assessed in proportion to the benefit to the land. They may also fill or drain any land, remove all obstructions to the natural flow of any watercourse and improve inadequate drains, or direct the owner to do so. If the owner refuses, the municipality may do the work required and recover the cost by suit in any court. (Doublerley-Florida)
W70-06015

WATER SUPPLY DISTRICTS: METROPOLITAN (PURPOSE, CREATION AND AUTHORITY).

Mo Ann Stat secs 247.230 thru 247.670 (1959).

Descriptors: *Missouri, *Water supply, *Water resources development, *Water distribution (Applied), Legal aspects, Legislation, Water utilization, Administration, Local governments, Political aspects, Water rates, Public utilities, Water works, Taxes, Assessments, Costs, Tax rate, Financing, Investment, Loans, Principal, Eminent domain, Condemnation, Cities, Water management (Applied), Interest.

Metropolitan water supply districts may be created within counties to secure a source of water on a larger scale than is feasible for public water supply districts and municipalities acting alone. Such metropolitan districts may sell water at wholesale to other systems and municipalities within the district. Territorial and political restrictions are placed upon the formation and control of the districts, including the necessity of obtaining consent from a municipality having a water supply system. Procedural requirements for district incorporation and membership, organization, compensation, election, and removal of a district's board of directors are enumerated. A board may: enter contracts and agreements to develop, construct, acquire or operate water supply facilities; issue and refund bonds; exercise the power of eminent domain; fix rates and collect for the sale of water; levy and collect ad valorem taxes; and exercise all rights and powers necessary to carry out the purpose of the district. Procedures are established for the levying of taxes, the changing of boundaries, the inclusion or exclusion of property, and the dissolution of a district. (Casey-Florida)
W70-06087

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, SUMMARY REPORT.

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06185

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME I - TEXT.

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06186

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME II - TECHNICAL APPENDICES.

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06187

PLANNING PROGRAM (1969).

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06B.
W70-06188

RECLAMATION AND REUSE - THE STATE OF THE ART,

Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 08D.
W70-06260

NOTES ON VIRGINIA WATER LAWS AND AGENCIES.

Virginia Dept. of Conservation and Economic Development, Richmond, Va. Div. of Water Resources.
For primary bibliographic entry see Field 06E.
W70-06297

3E. Conservation in Industry

POLLUTION CONTROL AND THE FEDERAL POWER COMMISSION,

For primary bibliographic entry see Field 05G.
W70-06292

3F. Conservation in Agriculture

SOIL NITRATE, SOIL WATER, AND GRAIN YIELDS IN A WHEAT-FALLOW ROTATION IN THE GREAT PLAINS AS INFLUENCED BY STRAW MULCH,

Agricultural Research Service, Mandan, N. Dak.
Northern Plains Branch.
For primary bibliographic entry see Field 021.
W70-06002

HOW TO INSTALL FLEXIBLE MEMBRANE CANAL LININGS,

Tyler H. Quackenbush.
Agricultural Engineering, Vol 48, No 9, p 500-501, September 1967.

Descriptors: *Irrigation canals, *Installation, *Membranes, *Canal linings, *Linings, Plastics, Canal construction, Canal design, Irrigation, Irrigation ditches, Water conveyance, Seepage, Foundations, Synthetic rubber.
Identifiers: Seepage control, Butyl, Vinyl.

In areas in which seepage control is a problem or foundation conditions preclude more rigid types of linings, it is often preferable to use irrigation canal linings made of flexible membranes. Optimal membrane thickness depends primarily on subgrade conditions, with coarse soils requiring 8 mil vinyl or polyethylene and 15 mil butyl. 15 mil vinyl or polyethylene and 30 mil butyl would be necessary on gravel surfaces. When the subgrade is prepared prior to membrane installation, care must be taken to remove any objects which might puncture the lining. Backfilled anchor trenches on either side of the membrane are used to hold the lining in place. For longest membrane life, it is best to cover its entire surface with at least six inches of earth. This prevents deterioration by sunlight and damage by livestock. A side slope of about 3:1 is flat enough to retain the cover material. (Carr-Arizona)
W70-06007

SUBSURFACE IRRIGATION, HOW SOON A REALITY,

California Univ., Riverside.
Sterling Davis.
Agricultural Engineering, Vol 48, No 11, p 654-655, November 1967. 5 fig.

Descriptors: *Subsurface irrigation, *Irrigation engineering, *Irrigation, *Pipes, *Application equipment, Distribution systems, Irrigation systems, Irrigation design, Plastics, Plastic pipes, Conduits, Conveyance structures, Equipment, Application methods, Hoses, Installation, Durability, Costs, Root zone.
Identifiers: Flow continuity, Root penetration.

The major reason for interest in subsurface irrigation is the possibility it holds for even, automatic water application combined with reduced evaporation losses. One of the crucial components of a subsurface irrigation system is the applicator which transfers water from the pipe to the soil. A successful applicator must have the qualities of durability, flow continuity, economy, easy installation, easy replacement, and resistance to root penetration. These qualities were evaluated for several underground water applicators. Applicators are described and their test performances discussed. (Carr-Arizona)
W70-06008

RELATIONSHIP OF WATER QUALITY AND SOIL PROPERTIES TO SEEPAGE PROBLEMS,
Seepage Control Inc., Phoenix, Ariz.
For primary bibliographic entry see Field 03C.
W70-06009

ECONOMIC COMPARISONS OF OPEN CONDUIT AND PIPE IRRIGATION DISTRIBUTION SYSTEMS,
Bureau of Reclamation. Div. of Irrigation Operations.

B. A. Prichard.
Proceedings, Seepage Symposium, Second, March 25-27 1968, Phoenix, Arizona, U.S. Department of Agriculture, Agricultural Research Service ARS 41-147:134-138. April 1969. 2 tab, 4 ref.

Descriptors: *Economic justification, *Conduits, *Distribution systems, *Benefits, *Costs, Canal linings, Canals, Canal seepage, Cost-benefit ratio, Intangible benefits, Tangible benefits, Economic feasibility, Economic efficiency, Economics, Decision making, Water conservation, Water supply, Irrigation canals, Irrigation operation and maintenance, Concrete-lined canals, Laterals, Canal design, Engineering structures, Water conveyance, Conveyance structures.
Identifiers: *Seepage control, *Bureau of Reclamation.

Discussed in this contribution is a Bureau of Reclamation study which concerns economic justifications for lining irrigation canals with concrete or using pipe systems. The Bureau reached the following conclusions: (1) The most significant factor in determining economic justification for canal lining is the value of water which the lining conserves. (2) Canal linings are generally economically justified in areas where irrigable land exceeds available water supply. (3) Other tangible benefits of canal lining include reduced right-of-way costs, reduced investment costs for storage and drainage systems, and reduced OM and R costs. (4) Among the intangible benefits are such items as improved safety and farm appearance and reduction in water contamination by herbicides. Study of a sample area showed that lined canals with open-lined laterals had the highest benefit-cost ratio and the greatest excess of benefits over costs. (See W70-06026). (Carr-Arizona)
W70-06025

NO-TILLAGE CORN - CHARACTERISTICS OF THE SYSTEM,
Agricultural Research Service, Washington, D.C.
Lloyd L. Harrold, Glover B. Triplett, and William M. Edwards.
Agricultural Engineering Vol 51, No 3, p 128-131, Mar 1970.

Descriptors: *Cultivation, *Weed control, *Herbicides, *Mulch, *Erosion control, *Soil moisture conservation, Crop production, Plant nutrients.
Identifiers: *No tillage, *Planting, Coshocton, Ohio.

No-tillage corn consists of killing existing vegetation with a herbicide that also prevents growth of weeds from seeds in the soil, planting corn seed with practically no soil disturbance, and harvesting the crop. Corn may be planted in either a killed sod or following a row crop. Herbicides are selected to kill specific types of vegetation. In areas where existing vegetation is difficult to kill, no-tillage culture is not recommended. Sod sprayed 2 weeks before corn planting provided much more mulch throughout the growing season than that sprayed 2 weeks earlier. Mulch protected the soil from erosion and conserved greater amounts of soil water by reducing evaporation, compared to conventional clean plowed corn fields. On well-drained soil near Coshocton, Ohio, corn yield by no-tillage practice averaged 116 bu/acre - 8 bu/acre more than that for conventional practice. Soil erosion was 24 and 1550 lbs/acre, respectively. Problems needing additional research are: optimum seedbed and land surface environment, unfavorable water and temperature conditions in poorly-drained soil, and pests. (Harrold-USDA, ARS)

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

W70-06039

INCORPORATION OF AGRICULTURAL RISK INTO WATER RESOURCES PLANNING MODELS,

Texas A and M Univ., College Station. Inst. of Statistics; and Texas A and M Univ., College Station. Water Resources Inst.

James Richard Conner.

Technical Report No. 25, Jan 1970. 108 p, 10 tab, 17 fig, 27 ref, 2 append. OWRR Project C-1227.

Descriptors: *Reservoir design, *Simulation analysis, *Optimization, *Hydrologic data, Risks, Irrigation, Benefits, Agriculture, Water resources.

Identifiers: Twin Buttes Reservoir Project, Marginal value product.

The combination of design variables that maximized the economic efficiency of the Twin Buttes Reservoir Project was determined using simulation analysis. Two approaches to the problem were used: (1) maximization of net benefits, (i.e. the traditional benefit-cost ratio approach), and (b) maximization of marginal value product net returns, treating the system as a business enterprise. Decision variables were: reservoir capacity, the number of acres to be irrigated, and the amount of water to be furnished to each irrigation acre, including rainfall. Three hydrologic risk elements were considered. They were: (a) reservoir inflows, (b) reservoir evaporation rates and (c) rainfall. The risk variables influenced the net benefits that were obtained from various combinations of levels of the decision variables. A comparison of the two approaches concluded that the primary net benefits produces more reliable information than the marginal value product approach. (Kribs-Cornell)

W70-06100

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FLOOD HAZARD INFORMATION, POTOMAC RIVER AND TRIBUTARY STREAMS, STAFFORD COUNTY, VIRGINIA.

Corps of Engineers, Baltimore, Md.

Corps Engineers Flood Hazard Information Report, November 1969. 4 p, 1 plate.

Descriptors: *Floods, *Virginia, *Flood forecasting, *Tides, Maximum probable flood, Design flood, Tidal effects, Hurricanes.

Identifiers: Potomac River, Intermediate regional flood, Standard project flood, Intermediate regional tide, Standard project tide.

Flood hazard information for the Potomac River and tributary streams in Stafford County, Virginia, was prepared to aid in the solution of local flood problems and in planning the best use of lands subject to overflow. The information is based upon available data on historic and current tidal heights, and technical studies bearing upon the occurrence and heights of tides in the Stafford County area. The data presented indicate the extent of past flooding and that which might result from probable future high tides; namely, Intermediate Regional Tides and Standard Project Tides. Intermediate regional tides have an average frequency of occurrence in the order of once in 100 years, and are determined from an analysis of known tides in the general area of study. Standard project tides are tides of rare occurrence, and generally are considerably higher than any tides that have occurred in the past. However, they should be considered in planning the use of flood plains. From the data presented, the depth of probable flooding, either by recurrence of the highest known tide or by occurrence of the Intermediate regional or Standard project tides, may be determined. (Knapp-USGS)

W70-05918

FLOOD PLAIN INFORMATION, LATTAS AND SAN DIEGO CREEKS, ALICE, TEXAS.

Corps of Engineers, Galveston, Tex.

Corps Engineers Flood Plain Report, June 1969. 43 p, 8 fig, 12 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: Alice (Tex), Standard project flood, Intermediate regional flood.

Flooding of Alice, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)

W70-05919

FLOOD PLAIN INFORMATION OF JACKSON RIVER, COVINGTON, CLIFTON FORGE AND ALLEGHENY COUNTY, VIRGINIA.

Corps of Engineers, Norfolk, Va.

Corps Engineers Flood Plain Report, July 1969. 39 p, 10 fig, 7 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: Jackson River (Va), Standard project flood, Intermediate regional flood.

Flooding of the Jackson River, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)

W70-05923

PROVISIONS AS TO DITCHES, DRAINAGE AND RECLAMATION (FINANCING DRAINAGE PROJECTS).

Ky Rev Stat Ann secs 269.010 - 269.140 (1963).

Descriptors: *Financing, *Kentucky, *Drainage, *Drainage districts, Government finance, Legislation, Ditches, Administrative agencies, Drainage systems, Taxes, Assessments, Payment, Local governments, Federal government, Legal aspects, Drainage programs, Drainage effects, Costs, Cost allocation, Tax rate, Political aspects, Land reclamation, Surface drainage, Land use, Land tenure.

Methods of funding drainage projects, largely through refunding bonds and taxes, and the organization and powers of drainage districts are set forth. The issue of refunding bonds is authorized to fund the activities of drainage districts. Drainage districts may accept federal benefits. The county is given the power to drain lands, and may utilize condemnation if necessary. If the cost of improvements is more than the annual revenue of the county concerned, an election must be held to provide funding. Counties may be split into taxing districts to pay for improvements. Provisions are made for the appointment of commissioners who may sell bonds and enter contracts. (Caldwell-Florida)

W70-06001

RELATIONSHIP OF WATER QUALITY AND SOIL PROPERTIES TO SEEPAGE PROBLEMS, Seepage Control Inc., Phoenix, Ariz.

For primary bibliographic entry see Field 03C.
W70-06009

PROVISIONS AS TO DITCHES, DRAINAGE AND RECLAMATION (ASSESSMENTS FOR DRAINAGE PURPOSES).

Ky Rev Stat Ann secs 269.150 - 269.200 (1963).

Descriptors: *Kentucky, *Taxes, *Drainage districts, *Government finance, Legislation, Judicial decisions, Drainage, Ditches, Administrative agencies, Drainage systems, Assessments, Payment, Local governments, Legal aspects, Drainage programs, Drainage effects, Costs, Cost allocation, Tax rate, Land reclamation, Surface drainage, Evaluation, Land use, Adjudication procedure.

Upon making a tax assessment for drainage purposes, the boards of commissioners of drainage districts must publish proper notice of the means of challenging such assessments. The Circuit Courts will pass on such challenges, and enter a final ruling on whether the assessments were properly made. Dates of assessment and due dates are specified, a discount being provided for prompt payment. Drainage districts shall have a general lien for all taxes upon the lands assessed and upon all personal property of the owners not otherwise exempt from execution. A ten year statute of limitations is provided for the enforcement of the lien. Districts may enforce their liens by moving for a 'show cause' order to be issued by the Circuit Court, or by suit in court. Such suit may be in law or equity, equitable actions being conducted like suits upon liens arising out of contracts. (Caldwell-Florida)

W70-06010

SEEPAGE AND SEEPAGE CONTROL PROBLEMS IN SANITARY LANDFILLS,

Los Angeles County Sanitation District, Los Angeles, Calif.

Frank R. Dair.

Proceedings, Seepage Symposium, Second, March 25-27, 1968, Phoenix, Arizona, U.S. Dept. of Agriculture, Agricultural Research Service ARS 41-147, April 1969, p 14-16.

Descriptors: *Water pollution, *Groundwater, *Seepage, *Landfills, *Solid wastes, Water pollution sources, Water pollution control, Public health, Environmental sanitation, Waste disposal, Disposal, Wastes, California, Percolating water, Percolation, Leaching, Aquifers, Water table, Water supply, Gases, Carbon dioxide, Methane, Barriers, Infiltration.

Identifiers: *Seepage control.

Groundwater pollution resulting from solid waste landfills has been the subject of intensive investigation in southern California. Although these studies have produced an enormous quantity of data, the major problems of groundwater pollution from landfills go unsolved. Research is needed to discover feasible yet sanitary methods of depositing refuse in direct contact with groundwater. Further study is also required to determine whether water does in fact leach through landfills in appreciable amounts and percolate down to the water table. Experimentation should also proceed in an attempt to develop barriers to prevent the escape of refuse-produced gases into the groundwater. (See W70-06012). (Carr-Arizona)

W70-06011

BATON ROUGE CONTRACTING CO V WEST HATCHIE DRAINAGE DISTRICT OF TIPPAH COUNTY (ADDITIONAL COMPENSATION SOUGHT FOR WORK NECESSITATED BY CAVE-INS).

304 F Supp 580-592 (N D Miss 1969).

Descriptors: *Mississippi, *Channel improvement, *Construction costs, *Bank stability, Drainage districts, Contracts, Slope stability, Soil conservation, Drainage, Intakes, Excavation, Construction, Channels, Canal construction, Land clearing, Specifications, Performance, Judicial decisions, Legal aspects.
Identifiers: *Cave-ins.

Plaintiff construction company sued defendant drainage district to recover for extra work incurred in performance of a contract for channel improvement. Defendant, in its invitations for bids on the channel improvement project, furnished specifications and drawings which indicated soil type and water level. As work progressed, plaintiff experienced sliding and caving-in of the channel bank which necessitated extra work in removing the dirt deposited by the cave-ins. Furthermore, the channel design called for construction of spur inlets as located on the drawings. Defendant moved these inlets to different locations and added more of them. Plaintiff sought compensation for the extra work caused by the cave-ins and the spur inlet locations. The court found that defendant's design was not defective. There was no latent condition not anticipated in the contract. Plaintiff was experienced in this field. He should have known from the drawings and specifications that cave-ins might be encountered in performance of the work. Recovery was denied. However, the increased costs of construction caused by defendant's changes were awarded to plaintiff. (Cuevas-Florida)
W70-06013

SECOND CLASS CITIES (CONSTRUCTION OF SEWERS).

Mo Ann Stat secs 88.443 thru 88.457 (1952).

Descriptors: *Missouri, *Cities, *Drainage systems, *Sewers, Drains, Public health, Condemnation, Legislation, Legal aspects, Municipal wastes, Urbanization, Sanitary engineering, Environmental sanitation, Drainage programs, Assessments, Water management (Applied), Sewage disposal, Engineering structures, Drainage engineering, Utilities, Cost allocation, Construction, Taxes.

The city council shall have the power to establish a general sewer system, composed of public, district, joint district and private sewers. Public sewers may be established along the principal courses of drainage. District sewers may be established within the limits of the district and connected with public sewers, other district sewers, or the natural course of drainage. The council shall construct sewers in each district whenever necessary for sanitary or other purposes. Joint district sewers are constructed by second class cities whenever it is necessary for a sewer to be constructed in any part of the city containing two or more sewer districts. The apportionment of the cost of constructing a joint district sewer is regulated. The council by ordinance regulates the construction of private sewers. No sewer shall run diagonally through private property when it is practicable to construct it parallel with one of the exterior lines of such property. No public sewer shall be constructed through private property whenever it is as practicable to construct it along or through a street or other public highway. The council has the power to condemn private property for public use, occupation of possession in the construction and repair of the general sewer system. Special tax bills for improvements are regulated. (Powell-Florida)
W70-06014

MUNICIPAL CORPORATIONS - GENERAL POWERS (CONTROL OF WATER SUPPLY AND WATERCOURSES).

For primary bibliographic entry see Field 03D.
W70-06015

PROTECTION FROM FLOODS.

Iowa Code Ann secs 395.1-395.5, 395.15-395.17 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Flood control, *Flood protection, *Local governments, Levees, Legislation, Boundaries (Property), Assessments, Taxes, Ditches, Jurisdiction, Watercourses (Legal), Condemnation, Right-of-way, Conduits, Channels, Bridge construction, Railroads, Legal aspects, Bridges, Cities, Costs, Cost repayment.

Cities and towns may alter and improve watercourses within their limits and widen or establish streets across and adjacent to such watercourses. Special taxes and assessments may be levied for this purpose. Property may be condemned within and outside city limits to give effect to these provisions. One hundred or more city taxpayers may petition the city council to undertake improvements on specific areas of land, and the city council may approve and begin the improvements. Improvements may cross the right-of-way of a railroad, and it will be the duty of the railroad to construct necessary bridges or be liable for the costs incurred by the city in building them. (Hubener-Florida)
W70-06016

IN-SITU-FABRICATED MEMBRANES.

Witco Chemical Corp., New York. Pioneer Div.; and Witco Chemical Corp., New York. Research and Development Lab.

Herbert Goldstein, and Samuel I. Horowitz. Proceedings, Seepage Symposium, Second, March 25-27, 1968, Phoenix, Arizona, U.S. Department of Agriculture, Agricultural Research Service, ARS 41-147, April 1969, p 57-60.

Descriptors: *Membranes, *Asphalt, *Fabrication, *Spraying, Canal linings, Linings, Seepage, Sealants, Permeability, Mixing, Equipment, Application equipment, Application methods, Rates of application, Rubber, Films, Elastomers, Viscosity.
W70-06042

A new system has been developed by which membranes can be fabricated in situ. Two low viscosity liquids are sprayed through two-component metering equipment directly onto the substrate to be covered. The substrate need not be perfectly level, and as long as no free water is present, can be wet or dry. When a spray tip of 25 mils or larger is used, an application rate of 6.5- to 7-gal/100 sq ft is recommended. The major advantages of this system over plastic films and sheeting are that no hand-sealing of materials is required and labor cost is much lower. Composition of the liquids cannot be revealed because patents are pending. (See W70-06018). (Carr-Arizona)
W70-06017

PINE SEEDLINGS RESPOND TO LIMING OF ACID STRIP-MINE SPOIL, Forest Service (USDA), Princeton, W. Va. Northeastern Forest Experiment Station. William T. Plass. U. S. Forest Serv. Res. Note NE-103, 8 p. 1969.

Descriptors: *Pine trees, *Lime, *Soil stabilization, *Strip mines, Reclamation, Spoil banks, Soil chemical properties, Fertilization, Appalachia, Kentucky.
Identifiers: *Acidic spoils, *Strip mine reclamation.

A greenhouse trial was made to determine the effect of three rates of liming on the growth of five species of pine seedlings in an extremely acid strip-mine spoil. Liming at the rate of 5 tons per acre-foot significantly increased the growth of four of the species. Tissue analysis indicated the growth rate may be related to a reduction in the concentration of the metallic ions of manganese, iron, copper, and zinc. (Plass-USFS)
W70-06037

WATER RESOURCES (MASTER WATER MANAGEMENT DISTRICTS).

Miss Code Ann secs 5956-101, 5956-103 thru 5956-106, 5956-108 thru 5956-110, 5956-114 (Supp 1968).

Descriptors: *Mississippi, *Water conservation, *Administration, *Water resources development, Legislation, Legal aspects, Drainage, Water utilization, Impoundments, Diversions, Recreation, Beneficial use, Drainage districts, Planning, Boundaries (Property), Water resources, Construction, Financing, Assessments, Regulation, Eminent domain, Surveys, Federal government, Water districts.

Identifiers: *Water management districts, Land acquisition, Bonds.

The purpose of this act is to provide for the creation of master water management districts. Districts will carry out works of improvement for the purposes of: (1) drainage; (2) flood damage prevention; or (3) conservation, development, utilization and disposal of water including the impoundment, diversion, flowage and distribution of waters for recreation, welfare and other beneficial uses. District authority is limited to plans for improvements developed and carried out in cooperation with federal agencies. District organization is initiated by petition to the chancery court. Districts will be created in accordance with provisions of this act. Boards of commissioners will be the governing bodies of the districts. The boards will have the power to: (1) contract; (2) adopt regulations necessary for carrying out the purposes of this act; (3) acquire land; (4) conduct surveys; (5) construct, maintain and operate works of improvement; and (6) do any and all things not inconsistent with the laws of this state in carrying out the purposes of this act. The boards are authorized to borrow money, issue bonds and tax district lands in proportion to the benefits accruing to them in order to finance district projects. (Keith-Florida)
W70-06042

INCORPORATION OF AGRICULTURAL RISK INTO WATER RESOURCES PLANNING MODELS.

Texas A and M Univ., College Station. Inst. of Statistics; and Texas A and M Univ., College Station. Water Resources Inst.

For primary bibliographic entry see Field 03F.
W70-06100

FLOODS FROM SMALL DRAINAGE AREAS IN CALIFORNIA, Geological Survey, Menlo Park, Calif. Water Resources Div.

Arvi O. Waananen. Geological Survey Data Compilation Report, July 1969. 201 p. 95 fig, 3 tab.

Descriptors: *Floods, *Small watersheds, *California, Data collections, Hydrologic data, Stream gages, Gaging stations, Stage-discharge relations, Surface waters, Discharge measurement, Hydrographs, Rain gages.
Identifiers: Flood data (Calif.).

An investigation of the magnitude and frequency of floods from California drainage areas generally of less than about 10 square miles was begun by the Geological Survey July 1, 1958. The objective of the program is to obtain sufficient basic hydrologic data to define for such areas the magnitude and frequency of floods on a regional basis for the entire State, and to obtain sufficient flood-hydrograph data, on a statewide basis, for detailed hydrologic study. The report consists of a tabulation of the annual peak stage and discharge, by water years, for each gaging station in the program. The discharge hydrograph and recorded graph of accumulated rainfall for significant peak discharges during the current year are included for stations that are equipped with water-stage recorders. Monthly and annual rainfall totals are given for the

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Group 4A—Control of Water on the Surface

recording stations. In addition, discharge hydrographs and precipitation graphs, as well as monthly and annual precipitation, published in previous annual reports, are repeated in this report to provide a complete record. Program activities during the current year and program plans for the following year are summarized briefly. (Knapp-USGS)

W70-06142

FLOOD PLAIN INFORMATION, CROOKED CREEK AND TRIBUTARIES, CENTRALIA, ILLINOIS.

Corps of Engineers, St. Louis, Mo.

Corps Engineers Flood Plain Report, July 1969. 60 p, 20 fig, 13 plate, 15 tab.

Descriptors: *Floods, *Flood damage, Illinois, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: Centralia (Ill), Standard project flood, Intermediate regional flood.

Flooding of Centralia, Illinois is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)

W70-06156

DRAINAGE (PROCEDURE FOR LANDOWNER TO IMPROVE DRAINAGE OF HIS LAND).

Conn Gen Stat Ann secs 52-456 thru 52-461 (1960).

Descriptors: *Connecticut, *Drains, *Drainage effects, *Drainage practices, Judicial decisions, Legal aspects, Legislation, Easements, Channeling, Controlled drainage, Obstruction to flow, Ditches, Flow, Water policy, Damages, Assessments, Administration, Drainage water, Riddance (Legal aspects), Canals, Culverts, Adjudication procedure, Costs, Cost allocation.

When a landowner wishes to drain his lands, he may do so by deepening or widening a natural stream. If he is unable to agree with adjacent landowners as to the mode of drainage and the amount of damages, he may make complaint to the superior court of the county for power to drain across the lands of adjoining proprietors. Upon the filing of such complaint, the court will appoint three disinterested landowners to assess the damages and determine a drainage method. Their report in writing may be attacked by any interested party for irregularity or improper conduct. Three other persons may reassess the damages upon appointment of the court. Such reassessment may also be set aside on a showing of improper conduct. Costs of these proceedings shall be awarded at the discretion of the judge except in reassessment cases, where the party filing for reassessment bears the costs when he does not receive a higher damage valuation as a result thereof. When a ditch or channel across low lands is used for drainage by an adjoining proprietor, any obstruction to such ditch must be removed at the expense of the dominant tenant. (Barnett-Florida)

W70-06180

PRELIMINARY MASTER PLAN FOR BOULDER CREEK FROM 24TH TO 30TH STREETS.

Wright-McLaughlin Engineers, Denver, Colo.

City of Boulder, Colorado, November 1969. 30 p, 4 fig, 3 tab.

Descriptors: *Flood control, *Runoff, *Drainage engineering, *Storm runoff, *Stream improvement, *Stream stabilization, *Channel improvement, *Snowmelt, Mountains, Stream erosion, Streamflow.

Identifiers: *Boulder (Colo), *Boulder Creek.

An environmental design team was organized to study flooding problems along Boulder Creek in Boulder, Colorado between 24th to 30th Streets. Severe flooding caused by a combination of precipitation and mountain snowmelts, usually occurring in May and June, prompted the engineering planning study. Flood control planning and engineering for this stretch of Boulder Creek is complicated by the presence of five vehicular bridges. The consensus of the team favored the (unconventional) concept of a heavily armored channel designed to carry the mean annual flood with an overflow area capable of transporting a 100-year flood through the project with one foot of freeboard. This would create a floodway approximately 150 feet wide. It is significant that the design team favored this novel approach over the historically popular approach of constructing the most hydraulically efficient higher-velocity channel. The report includes recommendations to Boulder citizens to arrange for flood insurance when the area is approved for insurance and the rates are set. The City and County of Boulder are counseled to delay further land development along the Boulder Creek channel and to be careful about upstream mountain subdivision road-cutting and land-clearing. The estimated construction costs to implement the proposed plan is \$550,000. (Poerntner-Chicago)

W70-06189

MASTER PLANNING FOR STORM RUNOFF FOR NEW NORTH/SOUTH RUNWAY AND ENVIRONMENTS—STAPLETON INTERNATIONAL AIRPORT.

Wright-McLaughlin Engineers, Denver, Colo.

City and County of Denver, Department of Public Works, November 1969. 39 p, 13 fig, 5 tab.

Descriptors: *Storm runoff, *Ponding, *Airports, *Detention reservoirs, *Drainage, *Drainage engineering, *Drainage programs, *Runoff, Pondage, Flood control.

Identifiers: *Denver, *Stapleton International Airport, *Master plan for storm runoff, Airport planning.

This engineering report is unique because it incorporates new and unconventional concepts in planning drainage facilities for removal of stormwater runoff. The master plan for providing stormwater drainage at Stapleton Airport emphasizes detention and slow discharge of runoff at outlet points. Conventional designs usually embody high discharge rates at outlets which promotes downstream flooding. The drainage of Stapleton Airport has been complicated by the construction of a new highway and a new runway, both of which combined to block overland drainage and discharge to Sand Creek. In addition, new land development nearby and the probability of constructing another runway further complicates the drainage problem. The engineers propose the development of unconcentrated overland flow planes as well as swales and grass-lined open channels on flat grades to convey runoff slowly to existing and proposed detention ponds and outlets. Rooftop ponding is recommended for new buildings proposed on and near the airport. Undersized storm sewers are recommended to force overland flow during intense storms—thereby reducing discharge rates and downstream flooding. (Poerntner-Chicago)

W70-06190

LEVEE AND DRAINAGE DISTRICTS (LOCATION OF DISTRICT IMPROVEMENT NEAR

PUBLIC HIGHWAY).

Iowa Code Ann secs 455.116-455.128 (1945), as amended, (Supp 1969).

Descriptors: *Iowa, *Drainage districts, *Levees, *Construction, Railroads, Legislation, Legal aspects, Bridges, Ditches, Drains, Highways, Watercourses (Legal), Right-of-way, Public utilities, Embankments, Engineering structures, Water control, Water management (Applied), Drainage systems, Drainage programs.

Within a levee or drainage district a levee, ditch, drain or improvement can be located and constructed within the limits of any public highway so long as public travel is not materially interfered with. Public highways may be established along and upon any levee or embankment. Any secondary road bridge may be moved, built or rebuilt where a levee, ditch, drain, or change of any natural watercourse crosses a public highway. Whenever a proposed levee, ditch, drain, or watercourse improvement crosses a railroad right-of-way, the county auditor shall notify the railroad company. Such company has a duty to construct the improvement according to the county engineer's plans and specifications. Such railroad company shall assume the cost of building, rebuilding, constructing, reconstructing, changing or repairing any culvert or bridge when such improvement is located at the natural waterway or place provided by the railroad company. Steam or electric railway companies shall furnish the drainage contractor with unrestricted passage for his equipment across their rights-of-way and telegraph, telephone and signal lines. Other public utilities shall also furnish such passage. Annexation of additional lands for a levee or drainage district is regulated. (Powell-Florida)

W70-06237

DAMS, MILLS (REGULATION OF CONSTRUCTION AND ALTERATION OF DAMS).

Mo Ann Stat secs 236.190 thru 236.280 (1952), sec 236.255 (Supp 1970).

Descriptors: *Missouri, *Dams, *Mills, *Water pollution control, Dimensions, Electric power industry, Regulation, Obstruction to flow, Streams Natural flow, Domestic water, Chutes, Aprons, Hydraulic structures, Currents, Fish passages, Navigation, Repairing, Abutments, Riparian rights, Water pollution, Pollution abatement, Maintenance, Legislation, Legal aspects.

Any owner of a dam, mill, electric power and light works, or other machinery may increase the altitude of his dam by permission of court. The inquest of the jury or the order of the court shall not bar actions for injuries caused by such construction, except such as were actually foreseen and estimated by the jury. The circuit court, upon petition, may prevent the erection or raising of any dam, stoppage or obstruction which shall operate as a nuisance, be injurious to other works constructed on the stream, or which shall pollute stream waters used for domestic supply. Dams shall have minimum chute or apron sizes providing for adequate flow of water and free passage of fish. Violations of this provision, resulting in a swelling of streams, shall be a misdemeanor. All dams, stoppages and obstructions not made according to law shall be deemed public nuisances. Persons having obtained permission to erect a dam but who fail to comply with the requirements of law shall forfeit the legal rights attendant with such permission. In the interest of navigation, the state may require the removal of dams or prohibit construction. Provisions outline penalties for building without permission and describe the procedures for diversion of streams. (Duss-Florida)

W70-06243

HOBAUGH V CUNNINGHAM (SURFACE WATER DRAINAGE ACROSS HIGHWAY).

Fayette Legal Journal, Vol. 10, p 57-60 (Fayette County Ct, Pa 1947).

Groundwater Management—Group 4B

Descriptors: *Pennsylvania, *Riddance (Legal aspects), *Surface drainage, *Surface runoff, Surface waters, Rain water, Natural flow, Waste water (Pollution), Ditches, Highways, Underground, Judicial decisions, Land use, Relative rights, Repulsion (Legal aspects), Legal aspects, Culverts, Waste water disposal, Land tenure.

Plaintiff, owner of rural land on the lower side of a hillside highway, sought to restrain defendants, owners of higher land on opposite side of the highway, from collecting surface water and discharging it, along with waste matter, through an underground drain to a ditch on the highway. From the ditch the discharge flowed through a culvert onto the plaintiff's land. The county court held for defendants, stating that no waste matter had been discharged into the ditch and that the mere accumulation of water on the roof and in the basement of a house on the higher land could be legally returned to the natural course into which it would otherwise flow. So long as he does not divert it from its natural channel or cause any unnecessary injury, the upper landowner may collect the surface water and increase its flow by either surface or underground drainage. (Hubener-Florida)
W70-06293

NAVIGABILITY IN THE MISSOURI RIVER BASIN,

For primary bibliographic entry see Field 06E.
W70-06294

LEVEE AND DRAINAGE DISTRICTS.

Iowa Code Ann secs 455.132 - 455.135 (1945), as amended (Supp 1969).

Descriptors: *Iowa, *Drainage districts, *Levees, *Drainage, Drainage systems, Legislation, Legal aspects, Watercourses (Legal), Assessments, Repairing, Construction, Maintenance, Eminent domain, Easements, Right of way, Erosion, Erosion control, Meanders, Streams, Natural streams, Administrative agencies.

When the establishment, change or repair of a drainage district or the change of a natural watercourse is unsuccessful for any reason either before or after the improvement is completed, the Board of Supervisors can re-establish such district or improvement. If any levee or drainage district or improvement is insufficient to properly drain all of the lands tributary thereto, the Board can establish a new district encompassing the old district or improvement in addition to the extra lands deemed necessary. Parties owning the old improvement which is so encompassed shall receive credit for the value of the old improvement when benefits and costs of the new improvement are assessed and apportioned. The Board has a duty to keep in repair any levee or drainage district or improvement. The governing body of the district may, by contract, conveyance or eminent domain, acquire the necessary lands or easements for making repairs or improvements. Districts established for the straightening, widening, deepening, or changing of a natural watercourse acquire an easement for the right of way of sufficient width to accommodate reasonably anticipated erosion and meander of such stream. In existing districts where a stream has by erosion appropriated lands beyond its original right of way, an easement for such erosion and meander may be acquired if it is more economical and feasible than the containment of the stream, in its existing right of way. (Powell-Florida)
W70-06295

RECENT DEVELOPMENTS AFFECTING PUBLIC LANDS OF THE STATES--1968,

For primary bibliographic entry see Field 06E.
W70-06296

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT,'

For primary bibliographic entry see Field 06E.

W70-06307

4B. Groundwater Management

HYDROGEOLOGIC INFORMATION ON THE GLORIETA SANDSTONE AND THE OGALLALA FORMATION IN THE OKLAHOMA PANHANDLE AND ADJOINING AREAS AS RELATED TO UNDERGROUND WASTE DISPOSAL,

Geological Survey, Washington, D.C.
James H. Irwin, and Robert B. Morton.
Report available free on application to U.S. Geological Survey, Washington, D.C. 20242. Geological Survey Circular 630, 1969. 26 p., 4 fig., 4 plate, 2 tab, 43 ref.

Descriptors: *Hydrogeology, *Water pollution sources, *Waste water disposal, *Injection wells, *Leakage, Texas, Oklahoma, Underground, Groundwater movement, Seepage, Aquifers, Brines, Saline water, Saline water intrusion.

Identifiers: Glorieta Sandstone, Ogallala Formation.

The Oklahoma Panhandle and adjacent areas in Texas, Kansas, Colorado, and New Mexico have supplies of fresh water and of oil and gas. The Ogallala and, in places, Cretaceous rocks produce fresh water through approximately 9,000 irrigation and public-supply wells and a large number of other wells. Disposal of oil-field brine and other wastes into the Glorieta Sandstone is of concern because of the possibility of pollution of the overlying fresh-water aquifers, particularly the Ogallala Formation. Permits for 147 disposal wells into the Glorieta have been issued in this area. In the report area, the Glorieta Sandstone lies at depths ranging from about 500 to 1,600 feet below the base of the Ogallala Formation. The rocks between those two formations are relatively impermeable but solution has resulted in collapse in some places, resulting in increased vertical permeability. This might result in movement of brine under hydrostatic head from the Glorieta Sandstone into overlying fresh-water aquifers. (Knapp-USGS)
W70-05922

A BRIEF STUDY TO EVALUATE THE OPTIMAL GROUNDWATER WITHDRAWAL IN A RELATIVELY LARGE RIVER BASIN IN THE NETHERLANDS,

Rijksinstituut voor Drinkwatervoorziening, Delft (Netherlands).

W. Visscher.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 181-191, 1968. 11 p., 5 fig., 1 tab.

Descriptors: *Withdrawal, *Groundwater recharge, *Watersheds (Basins), *Water balance, Rivers, Water table, Storage capacity, Runoff, Aquifers, Water yield, Precipitation (Atmospheric), Discharge (Water), Drainage systems, Safe yield.

Identifiers: *Netherlands, Dommel River, Noord-Brabant Province.

A study of water balance was undertaken to determine the optimum groundwater withdrawal in the Netherlands, specifically in the Dommel River basin. This sandy area has a shallow water table and consequently a low storage capacity. The underground runoff to the Meuse River Valley is surprisingly low; groundwater discharges mainly into the local drainage ditches and canals. Any increase of groundwater withdrawal will also decrease the discharge of groundwater into the local drainage systems. An indication of the magnitude of the net precipitation, discharge and the recharge of an aquifer can be obtained by using simple methods. A simple relationship between the groundwater withdrawal and the lowering of the water table is given for determining the maximum safe yield. (Carstea-USGS)
W70-05934

THE GROUNDWATER BALANCE VARIATION IN THE EXPLORATION AND DEVELOPMENT OF ARTESIAN BASINS,

For primary bibliographic entry see Field 02F.
W70-05935

ARTIFICIAL RECHARGE THROUGH INJECTION WELLS IN A SANDSTONE AQUIFER,

Nebraska Univ., Lincoln.
R. R. Marlette.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 300-308, 1968. 9 p., 5 fig., 2 tab, 4 ref.

Descriptors: *Artificial recharge, *Injection wells, *AQUIFERS, *Sandstones, Groundwater recharge, Pump testing, Withdrawal, Water levels, Piezometers, Saline water intrusion, Tracers, Nebraska.
Identifiers: *Sandstone aquifers.

Pump tests were made in an aquifer which is located within the City of Lincoln, Nebraska. Water level changes caused by withdrawal and recharge of single wells and of an entire wellfield were computed by using formulas for groundwater flow to wells. Computed and measured water levels of pumped wells were compared. Well designs for the recharge system, operating procedures, and the use of tracers and piezometric levels to define the recharge dynamics are described. Prevention of saline water intrusion into the wellfield by using injected water is also discussed. (Carstea-USGS)
W70-05940

NONSTEADY TWO-LAYER RADIAL FLOW TO WELLS,

Indiana Univ., Bloomington. Dept. of Geology.
Yaron M. Sternberg.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 329-342, 1968. 14 p., 3 fig., 1 tab, 11 ref, append.

Descriptors: *Groundwater movement, *AQUIFERS, *Drawdown, Wells, Boundary processes, Laplace equation, Hydraulic conductivity, Discharge (Water), Cost analysis, Steady flow, Unsteady flow.
Identifiers: Groundwater hydraulics.

Nonsteady flow toward a well penetrating two layers with different formation constants is analyzed for the constant drawdown case. The two layers are connected throughout the confined aquifer and cross flow from one layer to another can occur. The boundary value problem is solved using the technique of separation of variables and Laplace transformation. Exact solutions for the drawdown distribution around the well and the discharge at the face of the well are given for the nonsteady and steady cases. These solutions are in the form of a slowly converging infinite series and include an integral that must be evaluated numerically. The parameters appearing in these equations include the hydraulic conductivity of each of the layers and their thickness, the radius of the well, and the eigenvalues. The solutions presented can be used to determine the contribution of each layer to the total discharge. Decisions as to whether a well should be drilled deeper can be made knowing what the added discharge contribution is, and the cost involved in realizing the additional discharge. (Carstea-USGS)
W70-05944

NONSTEADY FLOW TO MULTIAQUIFER WELLS,

Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 02F.
W70-05956

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

APPLICATION OF ELECTRIC WELL LOGGING AND OTHER WELL LOGGING METHODS IN HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02F.
W70-06098

4C. Effects on Water of Man's Non-Water Activities

URBAN HYDROLOGY, STORM DRAINAGE, AND FLOOD PLAIN MANAGEMENT IN METROPOLITAN AREAS OF THE UNITED STATES,

American Public Works Association, Chicago, Ill.
Herbert G. Poertner.
Georgia Institute of Technology. Water Resources Center Report, August 1968. 28 p. OWRR Project X-102.

Descriptors: *Water management (Applied), *Non-structural alternatives, *Planning, *Governments, *Urbanization, Storm runoff, Water supply, Legislation, Regulation, Zoning, Flood plain zoning, Reviews.

Identifiers: *Urban hydrology.

Current practices in urban hydrology, storm drainage, and flood plain management are reviewed. These practices have characteristics which not only limit solutions to present problems but contribute to future problems. An illustration is the opposition by land owners and tax authorities to flood plain zoning. One alternative to the present unsatisfactory state of management is to establish a program responsive to all segments of the population. Major limitations of present practices in engineering and design are deficiencies in knowledge of urban hydrology, lack of analyses of accumulated data, and ineffective use of data for producing optimum designs of integrated drainage systems. Problems of urban drainage are primarily institutional. Enabling legislation is needed for management of water in entire metropolitan areas by a single authority. Programs on federal, state, and local levels for correction of deficiencies within present flood plains and drainage systems need development to serve existing communities as well as those that may emerge in the surrounding area. (Knapp-USGS)
W70-05960

EFFECT OF CLIMATE, IMPOUNDMENTS, AND LAND USE ON STREAM SALINITY,
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
Harry B. Pionke.

Journal of Soil and Water Conservation, Vol 25, No 2, p 62-64, March-April 1970. 3 p, 4 fig, 7 ref.

Descriptors: *Water chemistry, *Water quality, *Climates, *Land use, *Oklahoma, Salinity, Streamflow, Surface-groundwater relationships, Infiltration, Evapotranspiration, Percolation, Flood control, Reservoirs. Precipitation (Atmospheric).
Identifiers: Climatic change.

Average salinity of the Washita River in Oklahoma increased substantially between 1954 and 1967. Among all variables studied, climatic changes appeared to exert the greatest influence on stream salinity levels. After correcting for the effect of climatic change, the same trend of salinity increase remained and appeared to be more closely related to changing land use than to the recent introduction of numerous impoundments at upstream locations. (Knapp-USGS)
W70-06102

HYDROLOGIC EFFECTS FROM URBANIZATION OF FORESTED WATERSHEDS IN THE NORTHEAST,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station; and Pennsylvania State Univ., University Park, Pa.
Howard W. Lull, and William E. Sopper.
U.S.D.A. Forest Serv. Res. Pap., NE-146, 1969. 31 p, 4 fig, 4 tab, 46 ref.

Descriptors: *Urbanization, *Watershed management, *Interception, *Infiltration, *Streamflow, Overland flow, Runoff, Peak discharge, Soil moisture, Soil compaction, Water quality, Pennsylvania.

Urbanization of forest areas tends to reduce interception, reduce infiltration and increase overland flow, reduce soil-moisture storage, reduce evapotranspiration, increase runoff, increase peak flows, and reduce water quality. Annual maximum peak flows, annual hydrologic responses, and annual runoff were found (from actual streamflow records) to increase with progressive urbanization. The percentage of summer rainfall that appeared as runoff and the hydrologic responses were greater for partially urbanized watersheds than for mostly forested ones.
W70-06157

THE GEORGES RIVER HYDRAULIC, HYDROLOGIC AND RECLAMATION STUDIES,

New South Wales Univ., Kingston (Australia).
For primary bibliographic entry see Field 02L.
W70-06177

PRELIMINARY MASTER PLAN FOR BOULDER CREEK FROM 24TH TO 30TH STREETS.

Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-06189

MASTER PLANNING FOR STORM RUNOFF FOR NEW NORTH/SOUTH RUNWAY AND ENVIRONS--STAPLETON INTERNATIONAL AIRPORT.

Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-06190

RECENT DEVELOPMENTS IN WATER LAW (LANDOWNER'S RIGHT TO MAKE REASONABLE USE OF PREMISES),

Clyde, Mecham and Pratt, Salt Lake City, Utah.
For primary bibliographic entry see Field 06E.
W70-06284

4D. Watershed Protection

SOIL CONSERVATION AND FLOOD CONTROL DISTRICTS.

Iowa Code Ann secs 467C.1-467C.6 (Supp 1969).

Descriptors: *Iowa, *Soil conservation, *Flood control, *Drainage districts, Local governments, Soil erosion, Drainage programs, Erosion control, Strip mines, Surface drainage, Levees, Legislation, Flood protection, Water control, Public health, Economics, Jurisdiction, Legal aspects, Administrative agencies, Financing, Assessments.

The board of supervisors of any county may establish districts for the purpose of soil conservation and flood control and may construct improvements and facilities to effect such purposes. Boards may cause any soil removed in mining operations to be replaced at the termination of such operations. Districts may combine in their functions activities affecting soil conservation, flood control and drainage. The word 'drainage' shall be deemed to

include in its meaning soil erosion and flood control, and the term 'drainage district' shall include districts having the purpose of soil conservation or flood control. Financing procedures and assessments are provided. (Hubener-Florida)
W70-05990

POLICE POWER - LANDS - CONSERVATION COMMISSION (IMPROVEMENTS TO WATER-BODIES ON PRIVATE PROPERTY).

Iowa Code Ann secs 108.7-108.10 (1949), as amended, (supp 1970).

Descriptors: *Soil conservation, *Watershed management, *Stream improvement, Accretion (Legal aspects), Conservation, Water conservation, Adoption of practices, Erosion control, Water resources development, State governments, Watershed management (Applied), Lakes, Stream erosion, Streams, Intermittent streams, Bank stability, Riparian land, Spillways, Streamflow, Regulated flow, Silting, Right-of-way, Easements, Administrative agencies legislation.
Identifiers: Artificial lakes.

With the consent of the owner, and subject to the approval of the Natural Resources Council, the Conservation Commission may enter private lands containing waterbodies draining into state-owned lakes and streams for the purpose of deepening, widening, filling, improving banks, constructing spillways, controlling erosion or providing structures to regulate stream flow. If the improvement is to improve the stream and not to prevent silting only, the agreement with landowner must include a public easement to the improved portions of the stream. Land created in areas under state jurisdiction remain under that jurisdiction until otherwise disposed of. In constructing artificial lakes on intermittent streams, the Commission cannot proceed with construction until soil conservation practices are in effect on at least 75 percent of the watershed or until the watershed land owners sign a soil conservation farm plan showing a willingness to carry on such practices. (Doublerley-Florida)
W70-05993

SWAMPY FORESTS AND BOGS OF SIBERIA,

For primary bibliographic entry see Field 03B.
W70-06034

STORAGE AND DELIVERY OF RAINFALL AND SNOWMELT WATER AS RELATED TO FOREST ENVIRONMENTS,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02A.
W70-06038

SEDIMENT MEASUREMENT TECHNIQUES: C. ACCELERATED VALLEY DEPOSITS.

For primary bibliographic entry see Field 02J.
W70-06110

PRELIMINARY DETERMINATIONS OF SEDIMENT DISCHARGE IN SAN JUAN DRAINAGE BASIN, ORANGE AND RIVERSIDE COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02J.
W70-06144

PUBLIC ATTITUDES TOWARD WATERSHED MANAGEMENT,

For primary bibliographic entry see Field 06E.
W70-06286

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION,

For primary bibliographic entry see Field 06E.
W70-06300

Identification of Pollutants—Group 5A

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

THE SOLUBILITY OF OXYGEN IN WINKLER REAGENTS USED FOR THE DETERMINATION OF DISSOLVED OXYGEN,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 07B.
W70-05996

BIODEGRADATION OF LINEAR ALKALATED SULFONATES.
New York Univ., Bronx.
For primary bibliographic entry see Field 05D.
W70-06058

AUTOMATIC METHODS OF SOLVENT EXTRACTION: BATCH EXTRACTION OF LOW CONCENTRATIONS OF NON-IONIC DETERGENT FROM WATERS,
Laboratory of the Government Chemist, London (England).
R. Sawyer, P. B. Stockwell, and K. B. E. Tucker.
The Analyst, Vol 95, No 1128, p 284-290, March 1970. 7 p, 6 fig, 3 tab, 4 ref.

Descriptors: *Chemical analysis, *Detergents, *Water pollution sources, Analytical techniques, Instrumentation, Laboratory tests.
Identifiers: Solvent extraction techniques.

An automatic system for solvent extractions of trace chemicals from aqueous samples is described. The system has been applied to the determination of traces of non-ionic detergent in sewage effluents and river waters. The method has been assessed by measuring the non-ionic detergent remaining in the sample by the manual method after automatic extraction. (Knapp-USGS)
W70-06120

ULTRAFILTRATION OF AQUATIC HUMUS,
Norsk Institutt for Vannforskning, Blindern.
Egil T. Gjessing.
Environmental Science and Technology, Vol 4, No 5, p 437-438, May 1970. 2 p, 1 fig, 1 tab, 9 ref.

Descriptors: *Humus, *Water analysis, *Filtration, *Separation techniques, Water treatment, Organic matter, Color, Taste, Odor, Water chemistry, Water quality, Colloids, Biochemistry, Analytical techniques, Chemical analysis.
Identifiers: Aquatic Humus.

Filtration of aquatic humus through Diaflo ultrafiltration membranes suggests that approximately 10% of the organic carbon and 1% of the colored matter have molecular weight below 1,000. The experiments indicate also that about 50 and 90% of organic carbon and color, respectively, are found in the fraction which is not penetrating the filter which is supposed to retain molecules larger than 20,000 in molecular weight. (Knapp-USGS)
W70-06123

SEA SURFACE AS A SINK OF EMANATION PRODUCTS,
Weizmann Inst. of Science, Rehovoth (Israel).
Dept. of Isotope Research.
G. Assaf, and J. R. Gat.
Earth and Planetary Science Letters, Vol 7, No 5, p 385-388, February 1970. 4 p, 1 fig, 1 tab, 10 ref.

Descriptors: *Aerosols, *Fallout, *Path of pollutants, *Sea water, *Tracking techniques, Dusts, Particle size, Precipitation (Atmospheric), Radioactivity techniques, Instrumentation.
Identifiers: Aerosol removal, Scavenging.

The decay products of radon (Rn-222) and thoron (Rn-220) are attached to submicron particles and serve as natural aerosol particle tracers. It has been shown that radioactive disequilibrium between radon and its shortlived decay products, as well as between Pb-212 and Bi-212, results from the presence of a sink for atmospheric aerosol particles. This property of the emanation products-aerosol system is used to study the process of removal of particles at the air-sea interfaces. The extent of equilibrium between Radon-222 and its shortlived daughter products was measured in air over the Eastern Mediterranean Sea. The uptake of aerosols by the sea surface is estimated from this measurement. A measurable scavenging effect was found only under stormy conditions when wave heights exceed 3 m. Lead-212 concentrations in the surface air are consistent with these scavenging effects. (Knapp-USGS)
W70-06137

ISOTOPIC COMPOSITION OF SULFATE IN RAIN WATER, PISA, ITALY,
Comitato Nazionale per le Ricerche Nucleari, Pisa (Italy). Laboratorio di Geologia Nucleare.
G. Cortecchi, and A. Longinelli.
Earth and Planetary Science Letters, Vol 8, No 1, p 36-40, March 1970. 5 p, 2 fig, 1 tab, 15 ref.

Descriptors: *Sulfates, *Sulfur, *Stable isotopes, *Path of pollutants, Tracers, Tracking techniques, Atmosphere, Water chemistry, Air pollution.
Identifiers: Oxygen isotopes, Sulfur isotopes, Pisa (Italy).

The isotopic composition of both oxygen and sulfur has been measured in rain water sulfate over about one year. From the results obtained it is concluded that the main source of sulfate in rain water in Pisa is probably atmospheric oxidation of sulfur dioxide from industrial activity. (Knapp-USGS)
W70-06139

NEW DATA ON THE DIFFUSION OF IMPURITIES IN THE SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
R. V. Ozmidor, A. N. Gezentsvey, and G. S. Karabashev.
Transl from Izvestiya Akad Nauk SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 11, p 1191-1204, 1969. Atmospheric and Oceanic Physics, Academy of Sciences, USSR, Vol 5, No 11, p 686-693, November 1969. 8 p, 9 fig, 1 tab, 36 ref.

Descriptors: *Path of pollutants, *Diffusion, *Sea water, *Tracers, *Tracking techniques, Dye releases, Density stratification, Currents (Water), Surveys, Statistical methods, Diffusivity.
Identifiers: Eddy diffusion.

Some results of the study of turbulent diffusion of impurities in the sea using fluorescent tracers are reported. The equipment and method of the expeditionary work are described. Experiments were carried out in the Black Sea with both instantaneous and continuous tracer sources. Results are presented of measurements of tracer distribution along the axis and on cross sections of the diffusing streams, and also in diffusing patches. The tracer distribution, which depends on the scale of the phenomenon, is described by diffusion equations with calculated and assumed coefficients of diffusion. The sharp anisotropy of the diffusion process and the shear in the tracer located at different levels is explained by density stratification and the velocity gradient connected with the circulation currents in the upper layers of the sea. (Knapp-USGS)
W70-06158

POTENTIOMETRIC DETERMINATION OF AMMONIUM NITROGEN IN OILFIELD BRINES,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
A Gene Collins, Joe L. Castagno, and V. M. Marcy.

Environmental Science and Technology, Vol 3, No 3, p 274-275, March 1969. 2 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Water analysis, *Ammonia, *Nitrogen, *Brines, Oil fields, Aqueous solutions, Analytical techniques, Chemical potential.
Identifiers: Ammonium nitrogen.

A rapid method for the determination of the ammonium nitrogen in saline waters was needed for petroleum geochemical and water pollution research. People at the Bureau of Mines developed a method using the reaction of formaldehyde with ammonium nitrogen and potentiometric determination of the strong acid produced. The ammonium nitrogen content of a saline water containing more than 3.9 mg of ammonium nitrogen per liter can be determined by the procedure in less than 30 minutes. A single laboratory relative standard deviation of 1% and a relative error of -2.8% were obtained when the concentration of ammonium nitrogen was 77.5 mg per liter in the presence of sodium chloride. (Knapp-USGS)
W70-06160

GEOCHEMISTRY OF SOME TERTIARY AND CRETACEOUS AGE OIL-BEARING FORMATION WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
For primary bibliographic entry see Field 02K.
W70-06178

AUTOMATED ANALYSIS FOR NITRATE BY HYDRAZINE REDUCTION,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Engineering Section.
L. J. Kamphake, S. A. Hannah, and J. M. Cohen.
Water Research, Vol 1, p 205-216, 1967. 6 fig, 3 tab, 9 ref.

Descriptors: *Automation, *Analytical techniques, *Nitrogen, *Nitrates, Water properties, Hydrogen ion concentration, Temperature, Ions, Sampling, Opacity, Sewage, Impoundments.
Identifiers: *Hydrazine reduction, Diazotization coupling reaction, Technicon AutoAnalyzer, Hydrazine sulfate.

Automated determination of nitrites and nitrates in water comprises two stages. First, the content of nitrates is determined by diazotization-coupling reaction; then, nitrate is quantitatively reduced with hydrazine sulfate to nitrite, the content of which is determined by the same diazotization reaction. The difference of the two determinations yields nitrite equivalent to nitrate of the sample. As many as 20 samples can be analyzed in 1 hour. Applicable range of the method is 0.05-10.0 milligrams/liter of either nitrite or nitrate nitrogen. The procedure has eliminated the difficulties encountered previously in reduction of nitrate in impounded waters by the use of zinc column. (Wilde-Wisconsin)
W70-06219

MANGANESE IN PROCESS WATER OF THE TEXTILE INDUSTRY (IN FRENCH),
R. S. Ingols.
Tribune CEBEDEAU, Vol. 20, p 271-272, 1966 (in French).

Descriptors: *Manganese, *Water supply, Heat exchangers, Distribution systems.
Identifiers: *Manganese oxides, *Staining, *Fabrics, Dyehouse wastes.

Hazards arising in textile plant from the presence, usually seasonal, of manganese in surface water used as a water supply, are discussed. Accumulated deposits of manganese oxides in heat exchangers and distribution systems can be released by pressure surges and result in staining of white cloth and in shade changes in some dyes. Five methods of treating the water supply are suggested. (Robinson and Livengood-North Carolina State Univ)
W70-06270

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification of Pollutants

TEXTILE WASTE PROBLEMS,

R. S. Ingols.
Sewage and Industrial Wastes, Vol. 30, p 1273-1277, 1958.

Descriptors: *Biological treatment, *Trickling filters, *Activated sludge, Sulfides.

Identifiers: *Dyehouse wastes, Fiber wastes, Dyes, pH, Chromates, Synthetic detergents.

Starch, textile fibers, sulfides, and dyes are components of the wastes which should be reduced by biological treatment. High pH values, high salt concentrations, mildew resistant finishes, chromates, bleaching agents, and synthetic detergents are components which may interfere with biological treatment. Through design, it is possible to provide treatment of textile wastes by lagooning, trickling filters, or activated sludge. (Livengood and Robinson-North Carolina State Univ)
W70-06277

BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION,

South Dakota State Univ., Brookings.

Paul R. Middaugh.

Available from the Clearinghouse as PB-191 536, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report April, 1970. 14 p. OWRR Project A-019-S DAK (1).

Descriptors: Water pollution sources, *Farm wastes, Bacteria E coli, Coliforms, Pathogenic bacteria, *Sewage bacteria, E coli, Enteric bacteria, Streptococcus bovis, Streptococcus faecalis, *Pollutant identification.

The initial or laboratory research phase of objectives were achieved. These were to improve the specificity, speed and reliability to bacteriological methods for determining kinds and number of fecal bacteria in water resources. The major objective of distinguishing between human and animal sources of pollution was partially achieved by improved isolation of the rumen organism Streptococcus bovis. The objective of determining the survival of selected fecal coliform and fecal streptococcus in river water with and without filtration was completed in the M.S. Thesis study by Joseph Zerfas. He compared river water in laboratory flasks with environmental river exposure chambers to determine survival effect of temperature from 10 to 30C, decreased both coliform and streptococci equally with increased temperature. Added organic nitrogen fertilization of river from normal level 2.5 ppm N to 10 to 30 ppm N stimulated growth and lengthened survival time. Both kinds of organisms increased in survival in water with reduced dissolved oxygen compared to aerated water. In untreated river water fecal coliform bacteria lived longer than fecal streptococci, 7% and 0.1% survival respectively after 7 days. Water membrane filtered to remove protozoa gave 20% coliform and 100% streptococcus survival after 7 days. In M.S. Thesis study by L. Koupal, methods for detecting the rumen organism Streptococcus bovis resulted in a rapid, sensitive selective method using membrane filter for quantitative recovery from river water and selective medium incubated in 25% CO₂+75% N₂ gas grows S. bovis which is then detected by starch agar overlay. Only ruminants have S. bovis in numbers in feces so S. bovis in river survival studies was proven to be a useful tracer for ruminant pollution of surface waters. More rapid and sensitive methods for both indicator and pathogenic bacteria were being investigated when the project was terminated.
W70-06312

5B. Sources of Pollution

STUDY OF ESTUARINE POLLUTANT AND WATER QUALITY DISTRIBUTION IN THE NEW YORK CITY -- NEW JERSEY METROPOLITAN AREA.

Quirk, Lawler and Matusky, New York.

Interstate Sanitation Commission, September 1967. 63 p, 41 fig, 18 tab, 17 ref.

Descriptors: *Estuaries, *Water pollution effects, *Water pollution sources, *Mathematical models, *Hudson River, Model studies, Dissolved oxygen, Biochemical oxygen demand, Aeration, Reaeration, Path of pollutants, Water quality, New York, New Jersey, Urbanization, Cities.
Identifiers: Hudson Estuary.

One-dimensional, steady state models of the Arthur Kill-Raritan River-Raritan Bay-Newark Bay complex, and of the lower Hudson River-East River-Upper New York Bay complex were developed to yield tidal cycle, cross-sectional area-averaged concentrations of BOD and DO under equilibrium or steady state conditions. The model gives moderately good agreement with the three month summer averages of 1964. Parameters which required numerical evaluation for use in the model included flow, dispersion coefficient, unit rates of BOD decay, atmospheric reaeration and tidal exchange, waterway geometry and waste loading. Response of model-generated DO was more sensitive to changes in total loading than to any other single parameter. For the Hudson, the DO varied linearly with load, and less strongly with reaeration coefficient, decay coefficient, flow and dispersion coefficient. Total present loading on the Hudson River-East River complex is approximately 1,800,000 pounds BOD/day. On the basis of present New Jersey DO standards, about 450,000 pounds/day can be assimilated by the Hudson River-East River system. Eighty percent treatment of current sources from both states will reserve about 20% of this capacity for future use. (Knapp-USGS)
W70-05937

ACCUMULATION OF ELECTRODIALYTICALLY SEPARATED PHYSICO-CHEMICAL FORMS OF Ru-106 BY MUSSELS,

Institut Rudjer Boskovic, Zagreb (Yugoslavia).
Stjepan Keckes, Zvonimir Pucar, and Ljerka Marazovic.

Oceanology and Limnology, Vol 1, No 4, p 246-253, 1967. 2 fig, 2 tab, 11 ref.

Descriptors: *Mussels, *Physicochemical properties, *Electrodialysis, *Radioisotopes, *Water pollution sources, *Radioactive wastes, Sea water, Ion exchange, Metabolism, Fuels, Fallout, Salinity, Ions, Gamma rays, Radioactivity, Hydrogen ion concentration, Chlorides.
Identifiers: *Ruthenium-106, Uptake, Shells, Soft tissues, Reactors, *Mytilus galloprovincialis* Lam, Radiometric analyses, Nitrosyl-nitro complex, Marine environments, Contamination.

Radioruthenium, either from reactor fuel processing plants or from weapon fallout, is among the most important artificial sources of marine environmental contamination. It has been found that nitrosyl and chloride complex forms of ruthenium, in which it occurs most frequently as radioactive waste, are composed of several physico-chemical forms fairly stable in sea water and defined by their electrophoretic and chromatographic mobility. Ruthenium-106 nitrosyl-nitro and chloro complexes were separated in sea water by electrodialysis through ion-exchange membranes by a 5-compartment electrodialytic cell. In parallel experiments the biological uptake and loss of obtained 'anionic', 'cationic' and 'neutral' fractions were tested. Using mussels, *Mytilus gallo-provincialis* Lam, it was shown that the uptake activity is always higher in soft tissues than in shells. The uptake rate of ruthenium chloride complexes was higher than that of ruthenium nitrosyl-nitro complexes. The electro-dialytically separated fractions originating from the same stock gave significantly different uptake curves indicating different physico-chemical forms in the fractions. The differences in the loss of incorporated activity showed that various fractions were not bound in the animals in the same manner. (Jones-Wisconsin)
W70-05988

RESISTANCE TO CHLORINATED HYDROCARBON INSECTICIDES IN THREE SPECIES OF FRESHWATER FISH,
Mississippi State Univ., State College.
Denzel E. Ferguson, Dudley D. Culley, William D. Cotton, and Ross P. Dodds.
BioScience, Vol 14, No 11, p 43-44, 1964. 1 tab, 4 ref.

Descriptors: *Pesticide toxicity, Chlorinated hydrocarbon pesticides, Resistance, Fish behavior, DDT, Aldrin, Dieldrin, Endrin, Bioassay.
Identifiers: Golden shiners, Bluegill, Green sunfish, Toxaphene, Tolerance, *Gambusia affinis*.

Resistant and non-resistant populations of golden shiner, bluegill and green sunfish were exposed to five chlorinated hydrocarbon insecticides (DDT, toxaphene, aldrin, dieldrin, endrin). Resistant populations—those reared in insecticide-contaminated waters—were resistant to all test insecticides except DDT (based on 36-hour median tolerance limit (TLm)). Non-resistant population TLm's ranged from 1.5 ppb (bluegills—endrin) to 80 ppb (golden shiners—aldrin); resistant population TLm's ranged from 22 ppb (green sunfish-DDT) to 4750 ppb (golden shiners—aldrin). Observations of fish in aquaria indicated a respiratory mode of action for the toxicants used. Preliminary tests on seasonal changes in resistance indicate higher tolerances in March-April and in June-July. (Voigtlander-Wisconsin)
W70-05992

PROVISIONAL TIME-OF-TRAVEL FOR ILLINOIS STREAMS,

Illinois State Water Survey, Urbana.

For primary bibliographic entry see Field 02E.
W70-06035

AGRICULTURAL POLLUTION OF WATER BODIES,

Agricultural Research Service, Washington, D.C.
William M. Edwards, and Lloyd L. Harrold.
The Ohio Journal of Science Vol 70, No 1, p 50-56, Jan 1970.

Descriptors: *Water pollution, *Farms, *Livestock, *Phosphorus, *Nitrates, *Pesticides, *Soil conservation, Runoff, Erosion, Percolation, Sediment, Waste.
Identifiers: Lake Erie, Barnyard, Solids, Liquids.

Pollution of Ohio's water bodies is of growing public concern; industrial, urban, and rural sources are becoming the subject of critical examination. Rural sources are soil sediment, plant nutrients, animal waste, and pesticides. Pesticides and phosphorus are absorbed rapidly and strongly to soil particles. Therefore reductions in sediment, phosphorus, and pesticide pollution are achieved by soil-erosion-control farming practices. More acres need to be brought under erosion-control practices. Nitrates dissolve in water and are carried by surface flow to streams and lakes, and by percolating water to underground aquifers. Increases in the use of nitrogen fertilizer, in evidence almost everywhere, could result in serious contamination of water bodies, if soil enrichment greatly exceeds the crop demand. Areas where large-scale livestock and poultry production is concentrated are also potential sources of serious pollution. In Ohio, animal-waste pollution problems are being studied at The Ohio State University, and movement of pollutants in surface and subsurface waters on drainage plots near Castalia are being studied by the Ohio Agricultural Research and Development Center and on agricultural watersheds by USDA Agricultural Research Service at Coshocton, Ohio. (Harrold-USDA, ARS)
W70-06041

PHYSICAL AND ECONOMIC FACTORS ASSOCIATED WITH THE ESTABLISHMENT OF

STREAM WATER QUALITY STANDARDS, VOLUME I,
Iowa State Univ., Ames. Engineering Research Inst.
M. D. Dougal, E. R. Baumann, and J. F. Timmons. Available from the Clearinghouse as PB-191 167, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report ISU-ERI-Ames-64400, April 1970. 343 p. OWRR Project A-001-IA.

Descriptors: *Economics, *Mathematical models, Path of pollutants, *Waste assimilative capacity, *Water quality, *Water pollution, Biochemical oxygen demand, Computers, Dissolved oxygen, Quality standards, Rivers, Sewage treatment, Simulation, Streams.

A comprehensive study is reported of water pollution control and stream water quality as they relate to the establishment of stream and effluent standards. The ability of Iowa streams to assimilate organic wastes was determined on a state-wide basis, with three hydrologic-water quality regions being identified: Ideal, Good, and Poor. Quantitative values were assigned for low flow discharges in each region. The preliminary results indicate that the BOD loading in the streams must be limited to 10 - 15 mg/l to maintain the established dissolved oxygen standard of 4 mg/l. The physical characteristics of effluents from typical waste treatment processes were determined and related to mathematical models for BOD progression. A more refined BOD model was developed. A case study of the Skunk River at Ames revealed the nature of the response of an Iowa stream to discharge of effluents from a water pollution control plant. A digital computer model was developed for simulating, verifying and forecasting stream water quality. The results indicate three major factors influence stream quality: oxidation of the carbonaceous organic wastes contained in effluents, nitrification of nitrogenous compounds, and the effect of nutrient levels in causing a substantial algal response. The economic value of water pollution control was evaluated for the City of Ames. Present annual expenditures will double or triple in the future depending on the desired level of stream water quality.

W70-06094

EFFECT OF CLIMATE, IMPOUNDMENTS, AND LAND USE ON STREAM SALINITY,
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
For primary bibliographic entry see Field 04C.

W70-06102

CONCENTRATION OF DDT BY SEDIMENTED POLLUTING OILS,
Michigan Univ., Ann Arbor. Dept. of Industrial Health.
Rolf Hartung, and Gwendolyn W. Klingler. Environmental Science and Technology, Vol. 4, No. 5, p 407-410, May 1970. 4 p, 4 fig, 1 tab, 9 ref. PHS Grant No ES-00147.

Descriptors: *DDT, *Oily water, *Path of pollutants, *Solubility, *Bottom sediments, Oil-water interfaces, Water pollution effects, Water chemistry, Oil wastes.
Identifiers: DDT partitioning (Oil-water).

The occurrence of sedimented oils is widespread in areas with a history of repeated oil pollution. Concentrations of 0.5% petroleum oils in these sediments are a common situation. These oils can act as partitioners and concentrate nonpolar substances from water. For DDT, the partitioning coefficient between mineral oil and water was found to be 1.30 million. The partitioning coefficient for DDT and sedimented mineral oil was found to be 1.08 million in an artificial stream in the laboratory. In the environment (Detroit River, Mich.) regressions of DDT concentration in sediments, on oil concentration in sediments, indicate a significant relationship. Estimated partition coefficients for DDT between water and sedimented oils in the Detroit

River sediments were calculated to be at least 1.45 million. The biological implications of the concentrating behavior of these oils should be investigated. (Knapp-USGS)
W70-06122

MICROBIOLOGICAL FACTOR IN ACID MINE DRAINAGE FORMATION: A PILOT PLANT STUDY,
Carnegie-Mellon Univ., Pittsburgh, Pa.
For primary bibliographic entry see Field 05G.
W70-06128

ADSORPTION OF COPPER BY CLAY MINERALS, HUMIC ACID AND BOTTOM MUDS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Aquatic Weed Control.
For primary bibliographic entry see Field 02K.
W70-06135

ISOTOPIC COMPOSITION OF SULFATE IN RAIN WATER, PISA, ITALY,
Comitato Nazionale per le Ricerche Nucleari, Pisa (Italy). Laboratorio di Geologia Nucleare.
For primary bibliographic entry see Field 05A.
W70-06139

OIL ON THE SEA.
Massachusetts Inst. of Tech., Cambridge, Mass.

Proc of Symp on the Scientific and Engineering Aspects of Oil Pollution of the Sea, sponsored by Mass Inst Technol and Woods Hole Oceanogr Inst, held at Cambridge, Mass, May 16, 1969, Hoult, David P., Editor, New York, Plenum Press, 1969. 114 p.

Descriptors: *Oily water, *Offshore platforms, *Water pollution sources, *Water pollution control, Oil fields, Oil industry, Legal aspects, Legislation, International waters, Oil wells, Water pollution treatment.

Identifiers: Oil spills.

In the last decade, changes in the scale of operations required to find and transport oil have led to a pollution problem of major proportion: oil on the sea. These changes occurred slowly, and the change in magnitude of the possibilities for pollution went unrecognized until a series of dramatic accidents recently gave the problem wide-spread public notice. The Torrey Canyon and Santa Barbara episodes are discussed. A summary is given of our current understanding of the problem of oil on the sea. The first three articles deal with the biological effects of oil spills. The next four articles are discussions of various engineering problems which arise in attempting to deal with spilled oil. The development of supertankers for transporting oil and the legal and legislative government attempts to cope with this problem are discussed. (Knapp-USGS)
W70-06155

POLLUTION FACTORS AND TREATMENT OF TEXTILE WASTE WATERS,
P. W. Sherwood.
Textile Manufacturer, Vol. 91, p 235-238, 1965. 1 table.

Descriptors: *Oil, *Emulsions, Distillation, Coagulation, Heat, Filtration.
Identifiers: *Gravity separator, *Electrical demulsification, Cottrell demulsification flue gas.

The degree to which clean-up must be practiced is set by such various considerations as nature of the nuisance, the size of the refining operation, the volume of the receiving water, the proximity of downstream water consumers, as well as considerations of downstream fish life, characteristics of river flow, and temperature. A classification of aqueous contaminants arising from textile opera-

tions will break down to the following chief categories: oil, both free and emulsified; acid or alkaline solutions; inorganic salts; organic acids; and phenols or soaps of these compounds; suspended solid that increase the turbidity of the waters; and various phenolic, naphthenic, and organic sulphur and nitrogen compounds which are toxic to marine life and give rise to unpleasant taste and odour of the water. For removal of oily impurities, it is general practice to provide at least three different separator systems-for contaminated storm water, for contaminated cooling water, and for process water. For decontamination of separable oil containing water, gravity separators are in universal use. Treatment of oil-water emulsions may be supplemented by electrical processing and to a lesser extent by filtration or even centrifuging. Application of heat is usefully employed to break up a great variety of emulsions. Electrical demulsification is carried out by passing the emulsion between a pulsating direct current at high potential. (Robinson-North Carolina State Univ)
W70-06273

STREAM POLLUTION AND EFFLUENT TREATMENT, WITH SPECIAL REFERENCE TO TEXTILE AND PAPER MILL EFFLUENTS,
For primary bibliographic entry see Field 05D.
W70-06274

WASTE WATERS FROM THE WOOL INDUSTRY (IN RUSSIAN),
N. A. Lukinych.
Sanitarnaya Tekhnika Vol. 3, 1954. p 137-160.

Descriptors: *Waste Treatment, Neutralization, Centrifugation, Alkalinity.

Identifiers: *Waste water analysis, *Fiber production wastes, *Wool treatment wastes, *Wool grease recovery, Wool wastes, Spinning wastes, Weaving wastes, Wool grease, Acid treatment.

An investigation is described of the waste waters from a number of works of the wool industry; these are divided into three groups, those dealing with crude wool, spinning and weaving works, and works treating the prepared material. The water demand of 15 processes and analyses of their waste waters are given. Waste washing waters are alkaline, have high contents of suspended matter and grease, and have a high BOD. Waste waters from factories dealing with crude wool must be treated for removal of fibrous material and grease. Processes for removal of grease are described and a combination of centrifuging with acid treatment is recommended. (Livengood and Mattox-North Carolina State Univ)
W70-06280

BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 05A.
W70-06312

5C. Effects of Pollution

THE ECOLOGY OF PERiphyton IN WESTERN LAKE SUPERIOR: PART I - TAXONOMY AND DISTRIBUTION,
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 02H.
W70-05958

THE EFFECTS OF ELEVATED TEMPERATURE UPON AQUATIC INVERTEBRATES--A REVIEW OF LITERATURE RELATING TO FRESH WATER AND MARINE INVERTEBRATES,
John Hopkins Univ., Baltimore, Md. Dept. of Geography.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Loren D. Jensen, Robert M. Davis, Arthur S.

Brooks, and Caldwell D. Meyers.

Available from Edison Electric Institute, 750 Third Avenue, New York, N.Y. 10017, as EEI Publication No 69-900, Price: \$4.00. Edison Electric Institute Research Project No 49, Report No 4, September, 1969. 232 p, 6 tab, 14 fig, 384 ref. EEI Contract PG 49.2907.

Descriptors: *Reviews, *Thermal pollution, *Aquatic animals, *Water pollution effects, Heated water, *Aquatic environment, *Environmental effects, Ecosystems, Aquatic insects, Fish physiology, Crustaceans, Crabs, Lobsters, Crayfish, Isopods, Amphipoda, Copepods, Mollusks, Oysters, Clams, Mussels, Snails, Annelida.

Identifiers: Arachnida, Chelicerata, Sea spiders, Horseshoe crabs, Water mites, Scallops, Shipworms, Bryozoa, Ctenophora, Coelenterata, Roundworms, Echinodermata, Flatworms.

Literature directly concerning the effect of elevated temperatures upon both freshwater and marine invertebrates has been reviewed. A bibliography of 384 references has been included. The review has been limited to major invertebrate groups and does not, because of the lack of published data in some areas, include a uniform treatment of all the groups. The review was written as a source of information for the non-professional biologist. There are three sections. The first introduces the role of temperature in the biology-ecology of the aquatic ecosystem and the effect of temperature on the physio-chemistry of the aquatic environment. Section two is an introduction to major invertebrate groups, their morphology and life history, and a review of the published information on the effect of elevated temperatures on the whole animal and the effect on reproduction and development. The third section presents conclusions and interpretations drawn from the published data, including, brief presentations on: heat synergisms, order and duration of temperature response, physiological acclimation, short term effect of heat on critical physiological processes, species-individual reaction to heat, thermal tolerance to life stages, speciation resulting from thermal stress, thermal influences upon mechanisms of genetic variation, heat injury summary, and thermal influences upon food chain interrelationships.

W70-05962

EFFECT OF SUBLETHAL DDT ON THE LATERAL LINE OF BROOK TROUT, SALVELINUS FONTINALIS,

Carleton Univ., Ottawa (Ontario). Dept. of Biology.

John M. Anderson.

Journal Fisheries Research Board of Canada, Vol 25, No 12, p 2677-2682, 1968. 2 fig, 9 ref.

Descriptors: *Fish physiology, *Trout, *DDT, Behavior, Fish, Vibrations, Chlorinated hydrocarbon pesticides.

Identifiers: *Neurophysiology, Brook trout, Sublethal concentrations, Electrophysiology.

The normal multifiber response of the lateral line nerve to disturbance generated by a falling drop of water consists of a train of relatively large spikes. Responses are clearly distinguishable from spontaneous activity, are of short duration and apparently modified by water temperature (0.05 seconds at 5°C; 0.2 seconds at 14°C), and have a frequency of about 400 impulses per second. 24-hour exposure to sublethal DDT concentrations (0.1, 0.2, and 0.3 ppm) resulted in a marked prolongation of the response, especially at lower temperatures (4 to 5°C); no differences in frequency of responses were noted. Tests suggest that the observed negative temperature coefficient of the DDT effect on the lateral line nerve may be indicative of the effects of DDT on the entire sensory system. Experimental observations are discussed in light of other reported physiological and behavioral data. (Voigtländer-Wisconsin)

W70-05977

THEORETICAL ASPECTS OF THE COMPARABILITY OF PRODUCTIVITY DATA,

Freshwater Biological Association, Wareham (England). River Lab.

For primary bibliographic entry see Field 07B.

W70-05978

ON THE PRODUCTIVITY OF FIVE DANISH WATERS,

For primary bibliographic entry see Field 02H.

W70-05979

CHIRONOMIDS AND LAKE NUTRIENTS IN FLORIDA,

Florida State Board of Health, Vero Beach. Entomological Research Center.

Maurice W. Provost.

Sewage and Industrial Wastes, Vol 30, No 11, p 1417-1419, 1958. 4 ref.

Descriptors: *Midges, *Lakes, Nutrients, Florida, Pest control, Insect control, Eradication (Pests), Chemcontrol, Water pollution effects, Pesticides, Phytoplankton.

Identifiers: *Midge Investigation Program (Fla), *Chironomid midges, Glyptotendipes paripes, Lake May (Fla), Lake Lulu (Fla), Bloodworms, Winter Haven (Fla), Blind mosquitos, BHC, EPN, Sand bottoms.

Because of nuisance levels of chironomid midges in the area of Winter Haven, Florida, a survey was conducted to determine (1) the chironomid species present, (2) the association between the species and environments for the larvae, and (3) the association between chironomid production and the disturbances of the natural conditions in the lakes by cultural activities. Early attempts at chemical control of chironomid larvae were unsuccessful owing to development of larvicide resistance to both BHC and EPN. 13 lakes in the survey ranged from undisturbed (no homes, industries, sewage plants) to lakes having several possible nutrient sources, including urban development, cannery plants, citrus groves, septic tanks, and sewage plants. Preliminary results indicate that major pest, Glyptotendipes paripes, breeds on sand substrate irrespective of depth and other limnological variables (transparency, pH, alkalinity). Food of G paripes consisted of planktonic algae; feeding is non-selective and amounts of algae in stomachs were proportional to planktonic densities in the lake. On the basis of preliminary results, research has been initiated on biological studies of midges, comparative limnology of the selected lakes and control studies. (Voigtländer-Wisconsin)

W70-05980

BIOLOGICAL AND CHEMICAL SIGNIFICANCE OF SURFACE MICROLAYERS IN AQUATIC ECOSYSTEMS,

Virginia Polytechnic Inst., Blacksburg. Dept. of Biology; and Ryckman, Edgerley, Tomlinson and Associates, Clayton, Md.

B. Parker, and G. Barson.

BioScience, Vol 20, No 2, p 87-93, 1970. 75 ref.

Descriptors: *Lakes, *Oceans, *Surfaces, *Air-water interfaces, Seston, Oil, Oil-water interfaces, Aquatic environment, Surfactants, Water pollution sources, Retardants, Alcohols, Pesticides, Microorganisms, Phytoplankton, Toxins, Fish, Wildlife, Sampling, Red tide, Human diseases, Nitrogen, Phosphorus, Evaporation control.

Identifiers: *Microlayers, Slick hazards, Surface films, Oil spills, Outboard motors, Evaporation suppressant, Buoyant cells, Long-chain alcohols, Gas vacuoles, Neuston microorganisms, Microlayer sampling, Torrey Canyon oil spill, Aitken particles, 'Giant' hygroscopic nuclei, Foam aerosol content.

The objective is to establish the ecological importance of sea and freshwater basins surface microlayers. The thickness of this water film varies from a molecular monolayer to more than 1 millimeter, but the minute horizontal dimensions of this, one might say, 'hydroepidermis' is totally dis-

proportionate to its ecological significance. The zone near the air-water interface accumulates both airophobic and hydrophobic materials, including natural oils, seston, other buoyant cells, synthetic surfactants, long-chain alcohols, biocides, and many members of neustonic biota. In many instances surface microlayers carry much higher concentration of toxic substances than water at a few centimeters depth, a fact that may often be responsible for the deleterious effects of eradicants and detergents on the inhabitants of lakes, rivers, and seas. (Wilde-Wisconsin)

W70-05983

IN SEARCH OF A CLEAR SOLUTION,

David Jenkins.

Sweden Now, Vol 3, No 3, p 24-26, 44, 1969. 4 fig.

Descriptors: *Eutrophication, *Water pollution sources, *Water pollution effects, *Water pollution control, *Lakes, Costs, Waste treatment, Water supply, Aeration.

Identifiers: Reed cutting, Aluminum sulphate treatment, Government subsidies, Sweden.

Some of Sweden's water pollution problems consist of untreated waste discharges into many of its 100,000 lakes, rendering them unsuitable for recreation. The pollution sources of Lake Trummen were stopped, but the lake was 'dead'—strangled with plant growth, and a 16-foot sediment blanket. The attempted cure was to pump out the top 20 inches of sediment which contain most of the pollutants. Remedial attempts in other projects are: direct aeration with air pumps, aeration by pumping bottom water through an artificial stream and returning it to the bottom, and aluminum sulphate treatment, which mixes with phosphorus in the water, settles to the bottom, forming a harmless blanket. Reed mowing is being tried on Lake Hornborga, its level lowered to produce arable land but leaving the lake shallow, overgrown, and oxygen deficient. The government is subsidizing waste treatment plants at \$8 million annual rate, and subsidies for industrial pollution control are proposed which would cover up to 25% of the capital cost. The pollution of the Baltic Sea is increasing and becoming an international concern. (Powers-Wisconsin)

W70-05986

WASTEWATER POLLUTION AND GENERAL EUTROPHICATION OF A HYDROELECTRIC IMPOUNDMENT,

Department of Health, Rotorua (New Zealand).

L. W. Reid.

Journal of the Water Pollution Control Federation, Vol 38, No 2, p 165-174, 1966. 4 fig, 1 tab, 13 ref.

Descriptors: *Reservoirs, *Water pollution sources, *Diseases, Sewage bacteria, Sewage, Phosphorus, Enteric bacteria, Thermal stratification, Hydrogen ion concentration, Plankton, Temperature.

Identifiers: *New Zealand, Hepatitis, Gastroenteritis, Hydroelectric impoundments, Plankton blooms, Elodea canadensis.

The city of Mangakino obtains its water supply from Lake Maraetai, a hydroelectric impoundment in the Waikato River Basin, New Zealand. The city's sewer outfall is one mile below the intake. Outbreaks of infective hepatitis during 1958-1959 prompted a study to determine the relationship between the disease and pollution of the reservoir. Temperature readings revealed marked flowthrough below 20 feet during thermal stratification, and that the wastewater was warmer than the lake, causing it to rise to the surface. A dye test confirmed this and indicated that surface water movement was influenced by wind, independent of the general direction of flow through the lake. Extending the sewer outfall from just below the surface to a depth of 50 feet is expected to make surface pollution less likely, but still possible under isothermal conditions. In 1961, a prolific plankton bloom occurred in the lake. Major nutrient sources

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were traced to cultural development of the Waikato River drainage basin, aggravated by ponding of water in hydroelectric reservoirs, and by wastewater enrichment of surface waters. Extensive establishment of *Elodea canadensis* is expected to stabilize the ecology, diminishing future plankton blooms. (Haskins-Wisconsin)
W70-05987

BENTHIC MACROINVERTEBRATES AND PERiphyton.

Midwest Benthological Society.

Select and Current Bibliographies, 1967. 23 p.

Descriptors: *Benthic flora, *Benthic fauna, *Invertebrates, *Periphyton, *Bibliographies, Oligochaetes, Crustaceans, Diptera, Mollusks, Ecology, Technology.

Identifiers: *Macroinvertebrates, *North American benthos, Turbellaria, Polychaeta, Crustacean zooplankton, Plecoptera, Ephemeroptera, Odonata, Trichoptera, Megaloptera, Aquatic Hemiptera, Aquatic Coleoptera, Chaoboridae, Chironomidae.

This is a bibliography of North American benthic macroinvertebrates and periphyton. It includes primarily papers published in 1967 and those 1965 and 1966 publications not included in the preceding two bibliographies. Papers concerning species or genera not occurring in North America were excluded. The section titled 'General Aquatic Ecology' contains references that could not be conveniently placed in a specific group. Members of the Literature Review Committee are listed in the Table of Contents with their contributions. Eugene W Surber, Henry H Howell, and H F Clifford made sizable contributions to the sections on General Aquatic Ecology, and Techniques. The section titles are: Periphyton, Turbellaria, Oligochaeta and Polychaeta, Crustacea, Crustacean Zooplankton, Plecoptera, Ephemeroptera, Odonata, Trichoptera, Megaloptera, Aquatic Hemiptera, Aquatic Coleoptera, Diptera-Chaoboridae, Diptera-Chironomidae, Other Aquatic Diptera, Mollusca, General Aquatic Ecology, and Techniques. (Jones-Wisconsin)
W70-05989

AN ATTEMPT TO DETERMINE THE PRIMARY PRODUCTION OF THE GREEN SULPHUR BACTERIA, CHLOROBIUM LIMICOLA NADS, (CHLOROBACTERIACEAE),
Bialystok Medical Academy (Poland). Dept. of Biology.

For primary bibliographic entry see Field 02H.
W70-05991

KETHIKAN GATEWAY BOROUGH: WATER AND SEWAGE SURVEY.

Alaska State Housing Authority, Anchorage.

Available from the Clearinghouse as PB-189 139, \$3.00 in paper copy, \$0.65 in microfiche. May 69, 129p.

Descriptors: *Water supply, Municipal water, Water requirements, *Sewage treatment, *City planning.

Identifiers: Kethikan Gateway, Alaska.

The document is concerned with serious water and sewage problems in many areas within the Borough. The report provides a detailed engineering survey, setting forth in nontechnical language, information which would serve as a long range water and sewerage plan.

W70-06033

MARINE DISPOSAL OF SEDIMENTS FROM BELLINGHAM HARBOR AS RELATED TO SOCKEYE AND PINK SALMON FISHERIES,
International Pacific Salmon Fisheries Commission, Westminster (British Columbia).

J. A. Servize, R. W. Gordon, and D. W. Martens.

International Pacific Salmon Fisheries Commission, Progress Report No. 23, 1969. 38 p., 9 ref, 9 tab, 9 fig.

Descriptors: *Sockeye salmon, *Pink salmon, Disposal, Marine fisheries, Hydrogen sulfide, Sediment distribution, *Bottom sediments, *Pulp wastes, Fishkill, Dispersion, Biochemical oxygen demand, Turbidity, Toxicity.

Identifiers: Bellingham Bay, Washington, *Pulp fibers.

A recent proposal for dredging and marine disposal of sediment from Whatcom Waterway, Bellingham was of concern to fisheries agencies since the proposed disposal area was utilized by several fish stocks. Laboratory study indicated that two types of sediment were involved. Sediment from the inner harbor consisted primarily of putrefying pulp fibers which exerted a significant oxygen demand, created substantial turbidity, and were toxic to juvenile sockeye salmon because of their hydrogen sulfide content. Various methods of widespread dispersal to dilute the sediment appeared impractical, and it was concluded that land disposal of inner harbor sediment would be necessary to protect fish stocks. Sediment from the outer harbor was a natural silt, no containing hydrogen sulfide, but exerted an oxygen demand and created a highly turbid mixture which settled very slowly. Hydraulic dredging and local disposal adjacent to the outer harbor was recommended. (Sjolseth and Katz-Washington)
W70-06043

TEMPERATURE-INDUCED CHANGES IN THE OXYGEN EQUILIBRIUM CURVE OF THE BLOOD OF THE BROWN BULLHEAD, Ictalurus nebulosus,

Oregon Univ., Eugene. Dept. of Biology.

Gordon C. Grigg.

Comparative Biochemistry and Physiology, Vol 28, p 1203-1223, 1969. 6 tab, 8 fig, 38 ref. NSF Grant GA-422.

Descriptors: Thermal stress, *Water temperature, *Bullheads, Acclimatization, *Fish physiology, *Animal metabolism, *Hydrogen ion concentration.

Identifiers: *Hemoglobin, Ictalurus nebulosus, *Blood, Plasma, Erythrocyte, Temperature adaptation, *Oxygen equilibrium curves, Oxygen affinity.

The affinity of blood for oxygen is dependent on temperature, which would seem to present a disadvantage to those fishes which encounter large seasonal temperature changes. Considering the well-known acclimatory abilities of many fishes, it would seem reasonable to propose the occurrence of seasonal modification of blood oxygen equilibria to compensate for changes in temperature. In *Ictalurus nebulosus*, blood from one group of fish acclimated at 24°C showed a consistently higher oxygen affinity compared with a group acclimated at 9°C, when measured at the same temperature. This shift, accompanying thermal metabolic acclimation, minimized the effect of temperature on oxygen affinity. The shift did not persist when dilute solutions of hemoglobin were studied. No changes with acclimation were seen in the multiple hemoglobin pattern nor in blood pH. The erythrocyte, rather than the plasma, appears to be the site of modification. (Sjolseth and Katz-Washington)
W70-06044

THERMAL COMPENSATION OF RESPIRATORY ENZYMES IN TISSUES OF THE GOLDFISH (CARASSIUS AURATUS L.),

Duke Univ., Beaufort, N.C. Marine Lab.

Richard S. Caldwell.

Comparative Biochemistry and Physiology, Vol 31, p 79-93, 1969. 6 tab, 1 fig, 37 ref. NSF Grant G-17669.

Descriptors: Thermal stress, *Acclimatization, Water temperature, Enzymes, *Fish physiology, Fish behavior, Animal metabolism.

Identifiers: *Thermal compensation, *Temperature adaptation, Goldfish, *Cytochrome oxidase, *Carassius auratus*, ATP, Mitochondria, *Electron transport enzymes, ADP, Fish gills.

Cytochrome oxidase activity, determined over the range 10-40°C was higher at all assay temperatures in brain, gill and muscle homogenates of 10°C-acclimated goldfish than of 30°C-acclimated fish, but was only higher in liver homogenates when assayed at 30 and 40°C. Thermal compensation of gill cytochrome oxidase did not appear to involve a significant increase in the mitochondrial content of the cells. Cytochrome oxidase, succinate-cytochrome-c reductase and NADH-cytochrome-c reductase activities were all higher in gill mitochondrial preparations from cold-acclimated fish. The concentration of cytochrome-c1 was reduced in gill mitochondria of cold-compared to warm-acclimated goldfish. However, the concentrations of cytochromes-aa3, -b and c were similar to these two groups. It is suggested that mitochondrial electron transport systems compensate to the degree necessary to meet changing ATP demands of goldfish exposed to new environmental temperatures. (Sjolseth and Katz-Washington)
W70-06045

THE FAILURE OF OXYGEN TRANSPORT IN A FISH AT LOW LEVELS OF AMBIENT OXYGEN,

Sydney Univ. (Australia). School of Biological Sciences.

Gordon C. Grigg.

Comparative Biochemistry and Physiology, Vol. 28 p 1253-1257, 1969. 2 tab, 2 fig, 7 ref. NSF Grant GA-422.

Descriptors: *Fish physiology, Oxygenation, Bullheads, Oxygen requirements, Water temperature.

Identifiers: *Oxygen transport, *Blood, *Gills, Ambient oxygen tension, *Ictalurus nebulosus, Acclimation temperature.

Complete deoxygenation of arterial blood results in the failure of oxygen consumption in brown bullheads (*Ictalurus nebulosus*) at low levels of ambient oxygen. The arterial deoxygenation apparently results from inability of the blood to load oxygen across the diffusion barrier of the gills, since gill ventilation and perfusion continue after oxygen uptake ceases. The ambient oxygen tension at which this occurs differs appropriately in two groups of bullheads known to have different blood oxygen affinities as a result of thermal acclimation. The oxygen affinity of the blood is therefore strongly implicated as a factor limiting oxygen uptake at low levels of ambient oxygen. (Sjolseth and Katz-Washington)
W70-06046

THE CHEMICAL COMPOSITION OF THE WISLOK IN THE REGION OF KROSNOW AND ITS POLLUTION WITH HEAVY METALS (Cu, Cr, Ni), (IN POLISH),
Polish Academy of Sciences, Krakow. Lab. of Water Biology.

Maria Bombowna, and Stanislaw Wrobel.

Acta Hydrobiologica, Vol 10, No. 4, p 439-452, 1968. 2 tab, 6 fig, 6 ref.

Descriptors: Industrial wastes, Water pollution effects, Self-purification, Chromium, Copper, *Heavy metals, *Water quality, Water chemistry, On-site investigations, *Aquatic populations, Dissolved oxygen, *Sphaerotilus*.

Identifiers: *Cyanides, Nickel, Poland, *Wislok River.

The report describes the pollution of the water in the Polish river Wisłok in the region of Krosno with heavy metals (Cu, Cr, Ni) and cyanides in relation to the chemical composition of the water. By analysis carried out at various water levels three times a year it was established that this kind of pollution explained why the section of the river polluted with the sewage from the stream above was so very long.

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The comparison of the results of hydrochemical and hydrobiological investigations showed that a high concentration of heavy metals and cyanides transformed the river into desert, while even a low one affected most unfavorably the communities involved in self-purification. (Sjolseth and Katz-Washington)
W70-06047

A CHARACTERISTIC OF THE APPEARANCE OF BOTTOM FAUNA IN THE RIVER WISLOK NEAR KROSNÓ, (IN POLISH),
Polish Academy of Sciences, Krakow. Lab. of Water Biology.
Jerzy Zieba.
English Summary. *Acta Hydrobiologica*, Vol. 10, No. 4, p. 453-469, 1968. 1 tab, 1 fig, 13 ref.

Descriptors: *Benthic fauna, Density, *Industrial wastes, Chromium, Copper, *Community development, Domestic wastes, Oligochaetes, Aquatic populations, Tubificids, *Water pollution effects, Sphaerotilus, Dissolved oxygen, Aquatic insects, On-site investigations, Environmental effects water quality, *Heavy metals.
Identifiers: *Nickel, *Cyanide, *Poland Wislow River.

The density of settlement and also in a certain measure, the composition of bottom fauna depended in most of the investigated localities on the kind and concentration of impure waste waters. Industrial inorganic drains (Cr, Ni, Cu, CN) limited very strongly the quantitative and qualitative settlement on the bottom of the Marzec stream. Organic pollution (from domestic drains, vegetal from the linen factory, and animal from the plant for fattening store animals) mainly increased the number of Oligochaeta (mostly Tubificidae) and more rarely that of the Tendipedidae. The benthos had the greatest number of species on the upper unpolluted localities of the Wislok, where indicator species for pure running waters commonly appeared. (Sjolseth and Katz-Washington)
W70-06048

CHEMICAL INTERACTIONS OF WASTE WATER IN A SOIL ENVIRONMENT,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
B. F. Hajek.
Journal Water Pollution Control Federation, Vol 41, No 10, Oct 1969. p 1775-1786, 9 fig, 20 ref.

Descriptors: *Soil environment, *Disposal, *Waste water, Adsorption, Filtration, Cation exchange, Equilibrium, Dispersion.
Identifiers: *Assimilative capacity, *Chemical interaction, *Soil waste water reactions, Soil-column technique, Equilibrium technique, Biological degradation, Dynamic column technique, Hydrodynamic dispersion, Effluent analysis.

Experimental methods for predicting the assimilative capacity of soils for chemically contaminated waste water and the important chemical interactions when contaminated waste water is disposed into the soil are discussed. Laboratory studies were made to analyze chemical characteristics of waste water, soil and their chemical interactions. In order to assess fully the assimilative capacity of the soil with regard to waste water, the following major waste water parameters should be studied: pH, pollutant form and concentration, complementary ion concentration, temperature and volume-disposal characteristics. In regard to soil, the significant parameters are: grain size distribution, bulk density, mineralogical characteristics, ion-exchange capacity, and resident exchangeable cations. Soil waste water interrelationships are evaluated using batch equilibrium and soil-column techniques. In addition the characterization of the soil waste water reactions, pollutant migration rates and concentration distributions can be predicted using either theoretical or empirical approaches. (Shankar-Texas)
W70-06052

HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 05D.
W70-06095

EFFECTS OF SURFACE RUNOFF AND WASTE DISCHARGE INTO THE SOUTHERN SECTOR OF KANOEHE BAY: JANUARY-APRIL 1968,
Hawaii Univ., Honolulu. Water Resources Research Center.
Edison L. Quan, Reginald H. F. Young, Nathan C. Burbank, Jr., and L. Stephen Lau.
Technical Report No. 35, January 1970. 39 p, 2 tab, 19 fig.

Descriptors: *Estuaries, Surface runoff, Domestic waste, Water pollution effects, *Sewage effluence, *Enteric bacteria, *Nitrates, *Phosphates.

A study of the surface water quality in the southeastern portion of Kanoeha Bay was undertaken between February and mid-April, 1968. The aims of this project were to determine: (1) the effect of surface runoff on water quality in the Bay, (2) the chemical and bacterial content of wastewaters emerging from two sewage treatment plant outfalls, and (3) whether the overall water quality standards were met. High rainfall and subsequent high surface runoff introduce high concentrations of nitrate-nitrogen and fecal streptococci into the lower reaches of Keahala and Kanoeha streams. High concentrations of fecal streptococci also occur in waters overlying a clam bed during high stream flows, suggesting that a potential public health hazard may exist during the rainy period. High land runoff lowers the water temperature by 2 degree C over dry weather flow and causes silt turbidity along the nearshore waters in the Bay. Phosphate-phosphorus concentrations in the Bay waters at the location of waste discharge averaged 0.046 mg/l for the Kanoeha sewage treatment plant and 0.033 mg/l for the Kanoeha Marine Corps Air Station sewage treatment plant, exceeding the limit established for Class A waters by 0.021 and 0.008 mg/l, respectively. Surface runoff is not a significant contributor of phosphates into the Bay compared to the sewage waste discharge. In general, the dissolved oxygen content and pH adequately met the water quality standards at all stations except for two low dissolved oxygen readings in Keahala Stream. From mid-bay to the northern portion of the Bay, the parameters utilized indicated that the overall water quality met the standards established for both Class AA and A waters.
W70-06099

THE DELAWARE VALLEY ENVIRONMENT: STATUS AND PROSPECTS.
Greater Philadelphia Chamber of Commerce, Pa.; and University City Science Center and Inst., Philadelphia, Pa.
For primary bibliographic entry see Field 06G.
W70-06101

CONCENTRATION OF DDT BY SEDIMENTED POLLUTING OILS,
Michigan Univ., Ann Arbor. Dept. of Industrial Health.
For primary bibliographic entry see Field 05B.
W70-06122

OIL ON THE SEA.
Massachusetts Inst. of Tech., Cambridge, Mass.
For primary bibliographic entry see Field 05B.
W70-06155

THE BIOLOGICAL EFFECT OF COPPER SULPHATE TREATMENT ON LAKE ECOLOGY,
Wisconsin Committee on Water Pollution, Madison.
For primary bibliographic entry see Field 02H.
W70-06217

THE LIMNOLOGY OF CANYON FERRY RESERVOIR. IV. THE ESTIMATION OF PRIMARY PRODUCTION FROM PHYSICAL LIMNOLOGICAL DATA,
Montana State Coll., Bozeman. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 02H.
W70-06218

FACTORS CONTROLLING PRIMARY PRODUCTIVITY, ESPECIALLY WITH REGARD TO WATER REPLENISHMENT, STRATIFICATION, AND MIXING,
Biological Station, Lunz am See (Australia).
For primary bibliographic entry see Field 02H.
W70-06222

LIMNOLOGICAL ASPECTS OF RECREATIONAL LAKES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
For primary bibliographic entry see Field 02H.
W70-06225

SOME QUANTITATIVE ASPECTS OF ALgal GROWTH IN LAKE MENDOTA,
Wisconsin Univ., Madison. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-06229

PRIMARY PRODUCTION AND WATER QUALITY IN SMITH MOUNTAIN LAKE, VIRGINIA,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-06230

THE PRODUCTION OF ORGANIC MATTER BY THE PHYTOPLANKTON IN A DANISH LAKE RECEIVING EXTRAORDINARILY GREAT AMOUNTS OF NUTRIENT SALTS,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-06233

THERMODYNAMICS OF BIOLOGICAL SYNTHESIS AND GROWTH,
Stanford Univ., Calif. Dept. of Civil Engineering. Perry L. McCarty.
International Journal of Air and Water Pollution, Vol 9, No 10, p 621-639, 1965. 4 fig, 10 tab, 40 ref.

Descriptors: *Energy transfer, *Thermodynamic behavior, *Waste treatment, Microorganisms, Water pollution control, Nutrients, Synthesis, Metabolism.

Identifiers: Biological growth, Chemosynthetic autotroph growth, Anaerobic heterotroph growth, Free energy efficiency, Adenosine phosphate, Cell energy, Aerobic heterotrophic growth, Methane bacteria.

A study is made of the predictability of nutrient requirements for disposal of sludge by the activity of chemosynthetic autotrophs and anaerobic heterotrophs. The involved energy relationships are linked to adenosine triphosphate (ATP), each mole of which has an average production potential of 10.5 grams of dry bacterial tissue. A transfer of energy from substrate to the cells of microorganisms hydrolyses ATP to diphosphate (ADP), which is returned to the food source for a 'recharge' to triphosphate. The energy obtained by the cell is best indicated by the theoretical oxygen equivalent of the organic matter (chemical oxygen demand (COD)). In turn, the growth yield (f-sub-s) is given by the quotient of cells' COD over COD of the substrate utilized. The fraction of the substrate utilized for energy is then f-sub-e = 1 - f-sub-s. On these premises, the normal efficiency of energy transfer was estimated between 40 and 70% for both au-

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totrophic and heterotrophic bacteria under aerobic and anaerobic conditions. With certain exceptions, growth of microorganisms can be estimated by use of the relation between free energy of reaction, energy transfer efficiency, and energy requirements for synthesis and maintenance. (Wilde-Wisconsin)
W70-06234

THE PHOTOSYNTHETIC PIGMENTS OF LAKE SUPERIOR PERiphyton AND THEIR RELATION TO PRIMARY PRODUCTIVITY,
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 02K.
W70-06238

SOME EFFECTS OF THE KISSIMMEE RIVER CHANNELIZATION ON THE FISHERY RESOURCE,
Jon Buntz.

Report to Florida Game and Fish Commission May 1969. 11 p, 14 ref.

Descriptors: *Florida, *Channel morphology, *Aquatic environment, *Fish, Channels, Canals, Water conveyance, Meanders, Projects, Project planning, Channeling, Water conservation, Irrigation engineering, Drainage engineering, Environmental effects, Vegetation effects, Water pollution effects, Drainage effects, Fish migration, Fish conservation, Fish food organisms, Fish populations, Nutrients, Aquatic habitats, Flood control, Resource development, Water resources, Sedimentation.

This report was prepared to clarify and substantiate a previous report on the same subject. A copy of the original report is included in this article. As a result of channelization of the Kissimmee River, 99% of the productive area of the river will be destroyed. A comparison of a river and a parallel canal indicates the existence of more food fish in the river than in the canal. Channelization of a river reduces both the sizes and variety of aquatic life by destroying key productive areas. Channelization reduces a river's natural cleaning ability and results in siltation and sedimentation. However, channelization will cause a fluctuation of the water level on the reservoir marshes. Such fluctuation is desirable for fish and wildlife production. Migration of fish will be stopped by the project's control structures. If nutrients which encourage growth of aquatic vegetation in streams are removed, the water quality is improved. However, more nutrients will be available in the Kissimmee River since the filtering effect of the marsh has been reduced 92%. Pollution and vegetation will be increased. Channelization of the river will alter the fishing environment by eliminating natural protection previously afforded by the deep sheltering pools at the river bend meanders. The annual inundation of the Kissimmee River flood plain will be practically eliminated by the project plan, consequently reducing vast acreage of habitat attractive to waterfowl, fish and non-game species of wildlife. (Powell-Florida)
W70-06287

5D. Waste Treatment Processes

EFFECT OF ANTIBACTERIAL AGENTS ON MINE DRAINAGES, USE OF Viable ANTIBACTERIAL AGENTS TO REDUCE POLLUTION BY MINE DRAINAGES,
MSA Research Corp., Evans City, Pa.
For primary bibliographic entry see Field 05G.
W70-05959

CONTROL OF POLLUTION BY UNDERWATER STORAGE, FEASIBILITY OF PROVIDING TEMPORARY UNDERWATER STORAGE OF

STORM OVERFLOW FROM A COMBINED SEWER SYSTEM.

Underwater Storage, Inc., Washington, D.C.

Available from the Clearinghouse as PB-191 217, \$3.00 in paper copy, \$0.65 in microfiche. Water Pollution Control Research Series, DAST-29, 161 p, 9 tab, 56 fig, 12 ref, December 1969. FWPCA Program No. 11022 DWF--12/69.

Descriptors: *Pumped storage, *Waste storage, *Wastewater treatment, Overflow, Water storage, Water pollution control.

Identifiers: *Underwater storage, Storm overflow, Combined sewers, Pumping stations.

A pilot plant was designed, constructed and operated to assess the feasibility of providing a facility for the collection, treatment, storage and final disposition of a portion of the storm overflow from a combined sewer system serving a thirty-acre drainage area in Washington, D.C. A Parshall flume was installed in the overflow line for measurement of flow rates and determination of total overflow volume. A portion of the overflow was diverted to the pilot plant through grit chambers and a comminutor. Flow was stored in two 100,000-gallon underwater bags fabricated of nylon reinforced synthetic rubber and fastened to the river bed by a system of patented anchors. During the period of storage, compressed air was delivered to the tanks for agitation of the solids. Following cessation of the storm, contents of the bags were pumped to the interceptor sewer for delivery to the District of Columbia Sewage Treatment Plant at Blue Plains. Flow into and out of each underwater storage tank was metered and recorded. Samples of the combined sewage overflow discharged to the bags and pumped discharge from the bags were collected and subjected to laboratory analyses. During the operation period from January through September, 1969, a total of 1,600,000-gallons of diverted overflow from 38-storms was stored in the tanks. In addition, 600,000-gallons of river water was pumped into the underwater storage tanks for testing during dry weather periods. The total amount stored was pumped to the interceptor sewer in 26-separate pump out periods. The cost of the pilot plant was \$341,480.00, or \$1.70 per gallon of storage. This included facilities for testing, samples and flow measurement. Estimates for larger installations, without these special requirements range from 28.2 cents to 14.6 cents per gallon for plants with storage from two to twenty million gallons. The project demonstrated that temporary storage of overflow from combined sewers in underwater rubber storage tanks is feasible and may, under suitable conditions, be effective in eliminating direct, untreated discharge of combined sewage into surface waters during storm periods. Drainage area to be served, land use, nature of storm events, and other factors must be considered when planning an underwater storage facility.
W70-06029

DEVELOPMENT OF TERTIARY TREATMENT METHODS FOR WASTE WATER RENOVATION,

Texas Univ., Austin.
W. W. Eckenfelder, Jr.
Water Pollution Control, Vol 68, No 5, p 584-591, Sept-Oct, 1969. 3 fig, 4 tab, 26 ref.

Descriptors: *Tertiary treatment, *Costs, *Phosphorus, *Nitrogen, Adsorption, Filtration, Electrodialysis, Ion exchange, Reverse osmosis, *Waste water treatment, Filtration, Chemical oxygen demand, Operating costs, *Reviews.

A review of various tertiary treatment methods available to remove pollutants not ordinarily removed by conventional treatment processes is presented. Filtration removes suspended solids to less than 3 mg/l. Soluble COD has been reduced to 7 mg/l using adsorption on activated carbon. Removal of dissolved organics may be achieved by ion exchange, electrodialysis, and reverse osmosis.

Nutrients are treated separately. Phosphorus removals are possible by precipitation in primary systems, (80-90%), precipitation in aeration tanks, (50-92%), post-precipitation (90%) and luxury biological uptake (85-90%). Stripping, ion-exchange and nitrification followed by denitrification are described for nitrogen removal. Data on all the unit processes mentioned are given as are cost figures for: adsorption, ion exchange, nitrification and denitrification, chemical treatment, stripping, separation beds, carbon adsorption and electrodialysis. Operating costs for a 10 mgd plant utilizing primary clarification, activated sludge, phosphorus precipitation, nitrification-denitrification, filtration, and carbon adsorption is estimated to be 15 cents/1000 gallons. (DiFilippo-Texas)
W70-06049

FILTRATION OF TREATED SEWAGE EFFLUENT,

Stanford Univ., Calif.

George Tchobanoglous, and Rolf Eliassen. Journal Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA 2, p 243-265, April 1970. 17 fig, 4 tab, 27 ref. FWPCA Grant WPD 21-05.

Descriptors: *Filtration, *Equations, *Tertiary treatment, Filters, *Waste water treatment, Particle size, Zeta potential.

Identifiers: Straining.

Filtration studies were conducted on pilot scale activated sludge treatment plant effluent which was characterized by suspended solids, particle size, particle distribution, particle change and change distribution. Straining was found to be the principal mechanism responsible for the removal of particulate matter. Filter performance equations were developed for the conditions studied and were based on the size and distribution of particles, their floc strength, the size of the filter medium, the filtration rate and the amount of material arrested within the filter. These equations can also be generalized for cases where straining is not the principal removal mechanism. (Sorber-Texas)
W70-06050

AUTOMATED VARIABLE FLOW FOR PILOT PLANTS,

Minnesota Univ., Minneapolis.

Walter K. Johnson.

Environmental Science and Technology, Vol 4, No. 1, p 68-69, January 1970. 2 fig, 1 tab. FWPCA Project WP-01028.

Descriptors: *Pilot plants, *Automatic control, *Flow, Model studies, *Waste water treatment.

Identifiers: Sigma motor, Variable flow, Variable waste strength.

A new device has been developed which permits pilot plants to vary the rate of input flow continuously and automatically. A disk is used to produce a sinusoidal flow pattern. This is accomplished by pinning one end of a lever arm to the rotating disk and the other end to the zero-max speed controller. With the equipment studied (Sigmamotor) flow rates were varied between 13 ml/min and 3800 ml/min. (Hancuff-Texas)
W70-06051

GROWTH OF CHLORELLA PYRENOIDOSA 71105 IN ACTIVATED SLUDGE WASTE EFFLUENT,

General Dynamics Corp., Groton, Conn. Electric Boat Div.

Donald E. Leone.

Journal Water Pollution Control Federation, Vol 41, No 1, p 51-55, Jan 1969. 5 tab, 9 ref.

Descriptors: *Algae, *Activated sludge, *Effluents, Waste water reclamation, Waste water treatment, *Nutrients.

Identifiers: Mass culture of algae, Packed cell volume.

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Processed waste effluent was studied, using *Chlorella pyrenoidosa* 71105, as a method for algae growth and possibly waste water reclamation. Treated waste effluent, centrifuged and filtered twice through charcoal for removal of color, was supplemented with iron and/or urea and compared with DL-61 and EB standard algae media. While preliminary data revealed deficient magnesium, phosphorus, and sulfates and sufficient calcium, nitrogen, and iron for normal algal nutrients; supplementing waste effluent with iron was beneficial. Data revealed that effluent alone and effluent supplemented with urea showed a substantial lowering of doubling time and reduced PCV (packed cell volume). The waste effluent containing additional iron and urea showed higher chlorophyll content, although fewer cells were produced, when compared with effluent supplemented with iron and diluted standard media. Results indicated that processed waste effluent supplemented with iron (0.56 mg/l total) was a good medium for *Chlorella pyrenoidosa* 71105 and produced as much PCV as the diluted standard media. (Morgan-Texas)
W70-06053

PERFORMANCE CHARACTERISTICS OF AN OXIDATION DITCH,

University Coll., Dublin (Ireland). Dept. of Civil Engineering.

T. J. Casey, and J. P. Clerkin.

Water Pollution Control, Vol 68, No 6, p 687-695, Nov-Dec, 1969. 7 fig, 4 tab, 22 ref.

Descriptors: *Domestic wastes, *Treatment facilities, *Waste water treatment, *Biochemical oxygen demand, Dissolved oxygen, Effluents, Performance, Operational, Design data, Oxidation, Settling basins, Chemical oxygen demand.

Identifiers: *Oxidation ditch, Suspended solids, Extended aeration, Dublin (Ireland).

Analysis of the performance of an oxidation ditch for an equivalent population of 750 persons was made. A design loading of 1 lb BOD/d per 88 cu ft of ditch volume yielded a capacity of 7920 cu ft. An aeration rotor designed to yield 180 lb O₂/d was utilized. The oxygenation capacity of the rotor at various emersion depths was calculated and plotted. The response of the system to changes in rate of flow was quite rapid. There was no inflow to the plant for a 2-3 hour period each week day since a pharmaceutical waste was diverted. Plant performance evaluated under conditions of both overload and underload, 152 percent and 59 percent of design loading. BOD, COD, suspended solids, NH₄⁺ (as N4), NH₃ (as N) and pH of the influent and effluent were measured. Dissolved oxygen levels recorded continuously. BOD removal averaged 94.9 and 95.2 for the overloaded and underloaded conditions. Nitrification took place during both test series while some denitrification took place during the overloaded test series. The yield of excess sludge was within 20-30 g/inhabitant equivalent. Volatile content of the excess sludge varied between 67.5 and 72.0 percent. Peak oxygen demand for domestic sewage is 3 to 4 times the average BOD loading. Oxygenation capacity usually adapted in design is twice the average BOD loading, thus oxygen deficiency of limited duration may be experienced. (Galward-Texas)
W70-06054

FARM WASTES,

Netherlands Government Agricultural Waste Water Inst., Arnhem.

H. M. J. Scheltinga.

Water Pollution Control, Vol 68, No 4, p 403-413, July-August, 1969. 3 fig, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Activated sludge, *Aerobic treatment, Water pollution, Extended aeration, Fertilizers, Biochemical oxygen demand. Identifiers: *Oxidation ditch.

Manure in modern automated animal houses is often collected by falling through slatted floors into a channel. The final waste is a slurry and has little

value. Volume, dry matter, BOD, and total N values are listed for man, cow, calf, sheep, pig, and hen wastes. Anaerobic manure storage results in 50% BOD reduction. The usual disposal method is using a fertilizer, but there must be a demand within a reasonable distance. Volume reduction methods are: treat the slurry liquid portion separately; or dewater the slurry mechanically or thermally. Treatment by oxidation ditch is discussed. Average effluent figures, in mg/l, are: COD, 100-1000; BOD, 10-100; NH₃, 5-50; NO₂, 0-50; NO₃, 10-200; pH, 6.5-8.5. Oxygen concentration is important; and OC: load ratio of 2 is suggested for design. There was a 40-50% NH₃ and total N reduction when air was bubbled thru a pig waste, but no reduction occurred in a similar waste which has been poisoned with C (++) . It was concluded that mechanical ammonia stripping does not eliminate nitrogen compounds. Oxidation ditch construction is discussed. Costs of alternative disposal methods such as transportation to farm land or artificial drying must be considered when deciding which to use on oxidation ditch. (Steiner-Texas)
W70-06056

WATER POLLUTION CONTROL IN THE BURGH OF MOTHERWELL AND WISHAW,

D. H. Barracough.

Water Pollution Control, Vol 68, No. 1, p 102-117, Jan-Feb, 1969. 14 fig, 1 tab, append.

Descriptors: *Waste water treatment, *Activated sludge, *Operation and maintenance, Sewerage, Costs, Industrial wastes, Storm runoff, Effluents, Sludge treatment.

Identifiers: *Carbarns Works (England), *Clyde Park Works (England), *Coursington Works (England), *Combined sewers, Raw sewage.

General descriptions are given for unit operations at three sewage works: Carbarus, Clyde Park and Coursington. At the 3.0 MGD Carbarns Works excessive storm water flows created problems in operation. Sludge did not settle readily due to the excessive flows and organic matter lost through storm overflows combined with suspected toxic substances created digestion problems. Activated sludge averaged 73.4% BOD reduction with an air supply of 1.0 cu ft/gal. of sewage treated. Climatic conditions caused problems in sludge drying and it was found that drying beds 'topped' with ashes gave best results. The 30:20 standard was met at the 1.75 MGD Clyde Park Works with an air consumption of 0.6 cu ft/gal. Average BOD reductions were 83.2% in 1966. Sludge from the 0.9 MGD Coursington Works is stored before disposal at sea or tanked to the Clyde Park Works for digestion. (Berryhill-Texas)
W70-06057

BIODEGRADATION OF LINEAR ALKALATED SULFONATES.

New York Univ., Bronx.

Environmental Science and Technology, Vol 2, No 10, p 773-778, Oct 1969. 6 tab, 2 fig, 30 ref.

Descriptors: *Linear Alkylate Sulfonates, *Biodegradation, *Alkylbenzene sulfonates, *Detergents, Sulfur compounds, Degradation, Organic compounds.

Primary alkylbenzenesulfonates (PABS) and linear alkylbenzenesulfonates (LAS) are degraded biologically by the organism *Pseudomonas* via one of two oxygen demanding pathways, via benzoic or phenylacetic acid. Degradation of PABS with an odd number of carbon atoms and LAS with an even number of carbon atoms proceeds via benzoic acid. Degradation of PABS with an even number of carbon atoms proceeds via phenylacetic acid, and degradation of LAS with an odd number of carbon atoms proceeds by both pathways. (Hancock-Texas)
W70-06058

THEORETICAL STUDY OF HIGH-RATE SEDIMENTATION,

Camp, Dresser and McKee, Boston, Mass.

K. M. Yao.

Journal Water Pollution Control Federation, Vol 96, No 2, part 1, p 218-228, February 1970. 8 fig, 7 ref.

Descriptors: *Sedimentation, Design, Length, *Mathematical studies, Tubes, Uniform flow.

Identifiers: *High-rate sedimentation, Angle of inclination, Overflow rate, Parallel plates, Shallow tray.

A mathematical analysis is made for shallow tray, uniform flow, parallel plate, and circular tube high-rate settlers. The performance of high-rate settling system can be characterized by a parameter S which is a function of fall velocity of a suspended particle, the average velocity of flow through the settler, the relative settler length (ratio of length to depth), and the angle of inclination of the settler. A critical S value, Sc, can be defined. All particles with S greater than Sc are removed in the settler while the fractional removal of particles with smaller S values can be expressed as a function of S. An equation is developed to use overflow rate as a basis for designing a high-rate system. Analysis of the effects of relative length and angle of inclination on settler performance showed that performance increases sharply up to a relative length equal to 20 and performance decreases sharply as the angle of inclination exceeds 20 degrees. A discussion of design considerations and numerical examples are presented. (DiFilippo-Texas)
W70-06059

TERTIARY FLOCCULATION AND FILTRATION,

Dayton, Ohio.

DeFro Tossey, Paul J. Fleming, and Ronald F. Scott.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA1, p 75-90 Feb., 1970. 2 fig, 13 tab.

Descriptors: *Flocculation, *Tertiary treatment, *Filtration, Efficiencies, Biochemical oxygen demand, Nutrients, Phosphate, Sedimentation, Costs, Waste water treatment.

The conventional water treatment processes of flocculation, sedimentation, and filtration were studied in a 0.5 mgd pilot plant to demonstrate their applicability in tertiary treatment of trickling filter effluent. It was demonstrated that significant effluent quality improvements can be made employing these processes. Lime and alum were used as primary coagulants and activated silica, ferric sulfate and an organic polyelectrolyte were used as coagulant aids. Optimized treatment schemes and chemical dosages produced effluents containing 4 mg/l BOD₅, 25 mg/l suspended solids, and 5 mg/l phosphate. Capital and operating cost estimates for a full-scale plant treating 75 mgd of trickling filter effluent ranged from 37 cents/1000 gallons to 43 cents/1000 gallons depending upon the chemicals employed. (Sorber-Texas)
W70-06060

THE COST OF SEWAGE TREATMENT,

Newcastle-upon-Tyne Univ. (England).

R. M. Bradley, and Peter C. G. Isaac.

Water Pollution Control, Vol 68, No. 4, p 368-402, July-August, 1969. 37 fig, 14 tab, 20 ref.

Descriptors: *Cost analysis, Municipal wastes, *Capital costs, *Operating costs, *Waste water treatment, *Sewage treatment. Identifiers: United Kingdom.

A brief survey of capital and operating costs of municipal sewage treatment in the United Kingdom was prepared with data obtained from 12 consulting engineering firms and 34 treatment works. Difficulty was experienced in obtaining complete data, particularly in operating costs. The capital costs survey was based on 79 works; 40% served popula-

tions less than 5000 and 80% served populations in the 10000 to 50,000 range. Graphs were produced by a computer program using the least squares method to present capital cost data of totalworks, components, and associated costs as functions of population and/or capacity. The operating cost data was obtained from 34 treatment works serving populations from 100 to greater than 100,000; 54% served populations less than 10,000 and 91% served populations less than 50,000. Annual operating costs, excluding debt costs and with these costs included, are graphically presented for the most extensively used process, single filtration, as a function of population served. A relationship between annual operating costs and total capital costs as a function of debt charges, was determined and presented graphically. The average annual operating cost was approximately 3.1% of total capital cost. The debt charges represent approximately 69% of total annual operating cost. The main conclusion drawn from the survey was that data available are inadequate. (Morgan-Texas)
W70-06061

A SURVEY OF SOME SEWAGE TREATMENT AND ALLIED PROBLEMS AT NORWICH, 1963-1968,
Norwich Sewage Treatment Works (England).
P. Cotton.
Water Pollution Control, Vol 68, No 6, p 627-634, Nov-Dec, 1969. 3 tab, 25 ref.

Descriptors: *Activated sludge, *Sludge treatment, Sludge digestion, Sphaeratilus, *Sewage treatment, *Waste water treatment.
Identifiers: Trade effluent control, Filter pressing.

The city of Norwich sewage treatment works, built in 1963 with a design capacity of 7.5 mgd treated a flow of 9 mgd which has created several problems. Raw sludge pumped to the digestion plant created high peak rates of gas production causing reduced efficiency. In 1965 the screw pumps and pipework was modified to increase the gas storage space above the sludge and the surface area of the sludge, solving the problem. Due to extension designs, experimental treatments of sewage in a small-scale diffused air activated sludge plant were performed. Results were excellent and growths of Sphaeratilus were controlled by baffles fitted inside the aeration tank. Other experiments were done on filter presses using coagulants, copperas and lime, aluminum chlorhydrate and polyelectrolytes. Mixtures of primary, humus and activated sludges using copperas and lime gave reasonably dry cakes. The cost of the extensions designed were paid through trade effluent control and charges beginning mid-1966. (Waid-Texas)
W70-06062

FLOCCULATION OF NEGATIVELY CHARGED COLLOIDS BY INORGANIC CATIONS AND ANIONIC POLYELECTROLYTES,
Dow Chemical Co., Midland, Mich.
Arthur S. Teote, and Stacy L. Daniels.
Environmental Science and Technology, Vol 3, No 9, p 825-829, Sept 1969. 5 fig, 2 tab, 16 ref.

Descriptors: *Colloids, *Flocculation, *Sewage treatment, Waste water treatment.
Identifiers: *Polyelectrolytes.

The rates and degrees of flocculation of a monodispersed synthetic latex and a polydispersed raw sewage were determined optically after each system had been treated sequentially with inorganic cations and anionics polyelectrolytes. These anionic colloids are not flocculated significantly by anionic polyelectrolytes in the absence of multivalent cations. It was discovered that raw sewage colloids could be flocculated by anionic polyelectrolytes provided the metal cations were present. Multivalent cations work best in flocculation. Divalent cations which are naturally present in these colloids primarily govern the flocculation. Rates and degrees of flocculation of raw sewage were logarithmic functions of polyelectrolyte and

multivalent cation concentrations. (Hancuff-Texas)
W70-06063

OCEAN OUTFALLS MAINTENANCE AND REPAIR,
Los Angeles County Sanitation District, Calif.
Robert M. Powell, and Robert E. VanHeut.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1900-1904, Nov 1968. 2 ref.

Descriptors: *Outfalls, *Ocean, *Inspection, *Maintenance, Waste water, Corrosion, Marine plants.
Identifiers: *Los Angeles, Diffuser, Ballast.

The County Sanitation Districts of Los Angeles County own a complex system of trunk sewers, treatment plants, and ocean outfalls serving an area of approximately 700 square miles with an estimated population of 3,400,000 people. Discussed are the maintenance and repair problems of the districts four outfalls varying in size from 60" to 120" in diameter handling up to 450 mgd. Items to be maintained and methods thereof are included. Some examples of the problems are: (1) a buildup of grease, grit and gravel within the diffuser section, which was solved through bulkhead removal and flushing and (2) corrosion of joints which was minimized through anodic protection although material substitution is said to be better. Solution of specific area outfall problems also is covered. Conclusions indicate that periodic inspection and surveillance are the key to proper maintenance. (Hancuff-Texas)
W70-06065

THE OZONATION OF PHENOLIC WASTES,
Department of National Health and Welfare, Ottawa (Ontario).
Hugh R. Eisenhauer.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1877-1899, Nov 1968. 7 fig, 2 tab, 13 ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Ozone, *Phenols, Mathematical models, Treatment.
Identifiers: Catechol, Concentration, Ozonation, Ultraviolet analysis.

This research describes the effect of ozone on phenolic wastes. Ozone from a commercial ozonator was introduced into a glass reactor at room temperature with a porous glass dispersion tube and samples were withdrawn for phenol and catechol analysis. Catechol is the first oxidation product of phenol. The rate of phenol degradation was directly proportional to the phenol concentration, the ozone concentration in the gas feed, and the gas flow rate, and inversely proportional to gas bubble diameter. The kinetics of catechol degradation were similar. After an initial uptake of about 4 moles of ozone per mole of phenol the phenol and catechol had disappeared, however, degradation products continued to consume ozone at a slower rate and a constant efficiency of 50%. A reaction mechanism was proposed in the form of a mathematical model. (Hancuff-Texas)
W70-06066

ACTIVATED SLUDGE BASIC DESIGN CONCEPTS,
Kansas Univ., Lawrence.

Ross E. McKinney, and Walter J. Oferien.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1831-1843, Nov. 1968. 16 ref.

Descriptors: *Activated sludge, *Aeration, *Design, *Waste water treatment, History, Mixing, Settling basins, Sludge disposal.
Identifiers: Screening, Primary sedimentation, Secondary sedimentation.

The design of activated sludge systems has evolved slowly and progress has been made largely on an

empirical basis. This paper presents the basic design concepts for a modern activated sludge system including the foundations on which these concepts were developed. Design parameters developed for conventional and completely mixed systems indicate that aeration will be from 3 to 8 hours. Total MLSS will range from 1500 to 4000 mg/l, organic loads of 0.5 to 0.7 lb BOD/lb microbial solids will yield good operations, and diffused aeration of 1000 cubic feet of air per pound of BOD removed is a sound parameter. All aspects of activated sludge schemes are discussed with design parameters given. (Hancuff-Texas)
W70-06067

ECONOMIC EVALUATION OF AERATOR SYSTEMS,
Eimco Corp., Salt Lake City, Utah.
A. A. Kalinske.
Environmental Science and Technology, Vol 3, No 3, p 229-234, March 1969. 8 ref.

Descriptors: *Aeration, *Equipment, Performance, Economics.
Identifiers: *Diffused air, *Turbin dispersers, *Surface aerators.

Sound design principles and test procedures are set down for the selection of aerator systems. Basic design guidelines are given as well as methods of economic and technical evaluation which may aid engineers in designing aerobic biological treatment plants. The three principal oxygenation methods presented are: diffused air, turbin dispersion, and surface aeration. Equations are presented which may be utilized in the calculation of required horsepower for each aeration system. Sample calculations are given with the following results: diffused air—1.85 lbs O₂/HP-hr, turbin disperser—2.5 lbs O₂/HP-hr, and surface aerator—2.8 to 4.5 lbs O₂/HP-hr. A discussion on evaluation of aerator performance is given denoting some of the common pitfall. (Hancuff-Texas)
W70-06068

DITCHES PROVIDE EFFICIENT TREATMENT,
West Virginia Univ., Morgantown.
Jerry C. Burchinal, and Charles R. Jenkins.
Environmental Science and Technology, Vol 3, No 11, p 1170-1173, November 1969. 3 fig, 5 ref.

Descriptors: *Ditches, *Efficiencies, *Design, Sewage treatment, Capital cost, Operating cost, *Waste water treatment.
Identifiers: *Oxidation ditch, *Cameron (W Va), Velocity profile.

An evaluation of an oxidation ditch at Cameron, W. Va. is presented. The plant was designed for a population of 2400 and flow of 240,000 gpd. The ditch is 620 feet long, 4 feet deep, 16 feet top width and 9 feet bottom width. Two 8 ft 27 1/2 in diameter rotors operate at 75 rpm and 6 in submergence. The average retention time is 24 hours and flow velocity is kept at 1 fpm. Data collected from September 1965 - August 1967 showed flow variations between 69,400 - 438,000 gpd. The latter being influenced by combined storm water flow. At low flows efficiencies were: BOD 86-98%, SS 49-97%, ABS 74%. Maximum monthly average SS in ditch were 9941 which corresponded with highest efficiencies. D.O. variations within the ditch was between 5.2 and 9.0. Capital cost for an oxidation ditch is given as \$29 - \$68/1000 population with an average of \$45. (National Cost Index - April 1966) construction costs are \$0.35/gpd for population of 500 and \$0.83/gpd for 250. Annual unit operating costs are given as \$104.50/1,000,000 gallons. (Hancuff-Texas)
W70-06069

WASTE DISPOSAL FROM WATERCRAFT,
Cargo Carriers, Inc., Minneapolis, Minn.
Robert H. Hertzberg.
Journal Water Pollution Control Federation, Vol 40, No 12, p 2055-2058, Dec 1968.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Descriptors: *Pollution abatement, *Legislation, *Waste water treatment, BOD, Standards, Water Quality Act, Waste treatment, Nutrients.
Identifiers: *Watercraft, Devices, Coliform count.

The American Waterways Operators, Inc., a trade association representing water carriers of all types operating on the U. S. Inland Waterways feels that the establishment of standards for waste water discharge is a job of the federal government. In 1967 the individual states had watercraft laws which controlled watercraft discharge in varying degrees and which would create confusion if enforced as interstate measures. The Federal legislative background to date includes provisions in the Water Quality Act for state control and new bill HR 13923 (not yet passed) which puts pollution control of navigable waters in federal hands. Four types of control devices are discussed: (1) a holding tank which holds the waste until it can be transferred to a shoreline treatment facility, (2) a macerator which grinds and mixes the wastes with a chemical, usually chlorine, holds the waste for a period, then discharges, (3) incinerator which reduces the human waste to ash, and (4) self-contained recirculating device which removes the solids and purifies the liquid for reuse. (Hancuff-Texas)
W70-06070

MECHANICAL DEWATERING OF MIXED SLUDGES AT ANDOVER,
D. Hamilton.
Water Pollution Control, Vol 68, No 2, p 221-227, March-April, 1969. 3 tab, 2 ref.

Descriptors: *Sludge disposal, Biochemical oxygen demand, *Filteration, *Waste water treatment.
Identifiers: Andover (England), *Filtrate, Rotoplug sludge concentrator, Permanganate value.

The City of Andover, England operates a 1.35 million gal/day trickling filter plant. To facilitate sludge disposal a Rotoplug sludge concentrator was installed. This relieved the load on the cold digestion plant. The concentrator, which handles mixed raw primary and humus sludge, has 12 cells fitted with a nylon cloth 1.5 ft by 10.5 ft. The concentrator was expected to handle 18 pounds dry solids/cell per hour but over a two year period this figure ranged from 18.8 to 57.8 pounds dry solids/cell per hour. Over the same period efficiency of solids capture ranged from 33.6 percent to 83.4 percent. The filtrate, which is settled for one hour with the supernatant being sent to the sedimentation tanks and sludge to the digestion plant had BOD values in the range of 18,000 to 22,880 mg/l, permanganate values in the range of 2400 to 4720 mg/l and dry solid contents from 2.26 percent to 4.00 percent. After one hour of settling the values were 3400 to 4140 mg/l, 435 to 576 mg/l and .22 to .44 percent respectively. The cloths lasted 26 months. (DiFilippo-Texas)
W70-06071

THE INDUSTRIAL WASTES CONTROL PROGRAM IN NEW YORK CITY,
Department of Water Resources, New York. Bureau of Water Pollution Control.
For primary bibliographic entry see Field 05G.
W70-06072

MEMBRANE PROCESSES GAIN FAVOR FOR WATER REUSE,
Water Pollution Research and Applications Inc., Washington, D.C.
Jacob I. Bregman.
Environmental Science and Technology, Vol 4, No 4, April 1970, p 296-302. 4 tab.

Descriptors: *Tertiary treatment, *Reversed osmosis, *Electrodialysis, *Membrane processes, *Water reuse, Industrial waste treatment, Costs, Waste water treatment.

The results of studies with both reverse osmosis and electrodialysis has shown that it is technically feasible to convert sewage effluent to potable quality. The cost associated with treating secondary effluent by reverse osmosis is 22.4 cents/1000 gal. A comparable treatment through electrodialysis would cost 20.7 cents/1000 gal. The results from several reverse osmosis test facilities are presented. Typical results are 90-95% rejection of all species except nitrogen with complete removal of ABS, odor and turbidity. Several tables present the results of reverse osmosis treatment on such wastes as paper mill, brackish water, irrigation return, acid mine drainage, agricultural wastewater, and municipal wastes. Several of the associated problems are also listed, e.g. organic fouling of cellulose acetate membranes. (Hancuff-Texas)
W70-06073

COLLOIDS COMPLICATE TREATMENT PROCESSES,

Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab. Robert B. Dean.
Environmental Science and Technology, Vol 3, No 9, p 820-824, Sept 1969. 8 ref.

Descriptors: *Colloids, *Biological properties, Sewage treatment, Electrodialysis, Filtration, Activated carbon, Waste water treatment.
Identifiers: *Hydrocolloids.

Most of the colloidal material which remains in effluent from biological treatment plants is derived from the microbial organisms that bring about the treatment. A discussion is presented on the various types of flocculating material created by biological treatment. Although most of a polymeric flocculant should be absorbed at the optimum flocculant dose, activated sludge probably contains an excess of polymer that contributes to its poor dewatering properties. It is characteristic of polymer flocculants that they act as a dispersant when present in an excess over the optimum dose. Some of the colloid problems associated with advanced treatment processes are presented. Examples are rapid clogging of filters, the frequent backwash of activated carbon columns, and accumulation of colloids on electrodialysis units resulting in a reduction of salt flux. (Hancuff-Texas)
W70-06074

DETERMINATION OF EMULSIFYING OIL IN INDUSTRIAL WASTE WATER,

Detroit Metropolitan Water Service, Mich.
Michael J. Taras, and Karl A. Blum.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 2, p R404-R411, Nov. 1968, 4 tab, 4 ref.

Descriptors: *Chemical analysis, *Industrial wastes, *Oil, Salt, Waste water treatment.
Identifiers: *Emulsified oil, *Quantitative analysis, Determination, Recovery, Sodium chloride.

Scope of the current standard method for determination of grease can be extended to include emulsifying oils present in industrial waste water by saturating the acidified sample with sodium chloride before isolating the oils on the filter in the standard manner. This modification improved oil recoveries in every case over the wide variety of emulsifying oils tested. Even the most difficult sample was about 85% recoverable by this method. Comparative experiments with trichlorotrifluoroethane, and n-hexane as extracting solvents yielded similar results for the grease and oil samples. Trichlorotrifluoroethane was selected as the preferred solvent because of its non-flammability and higher specific gravity. (Hancuff-Texas)
W70-06075

UNDERGROUND DISPOSAL OF ACTIVATED SLUDGE,
Dow Chemical Co., Midland, Mich.
For primary bibliographic entry see Field 05E.

W70-06077

DEEDS AND DATA,

James E. Bailey, Arthur D. Caster, E. E. Ross, R. E. Hutson, and B. L. Loffell.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, 1953-1957, Nov 1968. 1 fig, 1 tab.

Descriptors: *Sewage treatment, *Data collection, Operations.
Identifiers: *Primary treatment, Arlington County (Va), Cincinnati (Ohio), Johannesburg (S Africa), Kenosha (Wis), Lewiston (Idaho), Middlesex County (NJ), Oakland (Calif), Plainesville (Ohio), Rockyhill (Conn), Vancouver (Canada).

Operating data from 10 primary treatment plants are presented. The plants examined had average BOD and suspended solids reductions of 36 and 58%, respectively, with average incoming wastewater parameters of 216 mg/l BOD₅ and 197 mg/l suspended solids. Grit removal varied from 0.18 to 1.60 cu. ft./1,000,000 gal. The data presented gives average, maximum and minimum daily flow, daily flow per capita, sewage temperature, sewage strength in terms of BOD and suspended solids both influent and effluent, and efficiency of treatment. In addition data is given on grit removed, surface overflow rate in the primary sedimentation tanks, sludge volume, dry solids, and percent solids. Disinfection and effectiveness are also presented. Complete data on digester operation is included. Some process problems and costs are discussed. (Hancuff-Texas)
W70-06078

AEROBIC DEGRADATION OF LONG CHAIN FATTY ACID SALTS,

Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr, and Joseph C. Roth.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 2, p R385-R403, November 1968. 10 fig, 2 tab, 22 ref.

Descriptors: *Anaerobic treatment, *Salts, *Metabolism, *Waste water treatment.
Identifiers: *Fatty acids, *Warburg, *Oxygen uptake, Acclimation, Grease, Long Chain Carbon.

Warburg studies were performed on calcium and sodium long chain fatty acids. Factors investigated included fatty acids from 8 to 20 carbon atoms, degrees unsaturation type of salt, concentration, and acclimation. Fatty acids studied were acetic, caprylic, lauric, palmitic, stearic, arachidic, oleic, linoleic, linolenic, petroselenic, elaidic and palmitoleic. The study showed the sodium salts of fatty acids with 18 or less carbon atoms can be metabolized in an aerobic system. Calcium salts of the same fatty acids also can be degraded, especially if they are finally pulverized. The rate of metabolism of the fatty acid salts decreases as the chain length of the compound increases. Acclimation of the organisms to saturated fatty acids with 16 or 18 carbon atoms increase the ease with which the compounds were degraded. (Hancuff-Texas)
W70-06079

COMPUTER ANALYSIS OF ENGINEERING ECONOMIC STUDIES,

Clinton Bogert Associates, Fort Lee, N.J.
For primary bibliographic entry see Field 06C.
W70-06080

OPERATING EXPERIENCES AT SWINDON, 1962-67,

Swindon (England).
W. F. Carmichael.
Water Pollution Control, Vol 68, No 4, p 458-464, July-August 1969. 9 tab, 6 ref.

Descriptors: *Sewage treatment, *Trickling filters, *Sludge disposal, Biochemical oxygen demand, Sludge digestion.
Identifiers: *Operation, *Storm sewage, *Swindon, England, Suspended solids.

Waste Treatment Processes—Group 5D

The sewage treatment works at Swindon, England, serves a drainage population of 120,300. Trade effluents constitute 6.5% of the sewage flow. From 1962 to 1967 ranges of influent BOD, suspended solids, and ammoniacal nitrogen were 272-410 mg/l, 397-534 mg/l and 40-49 mg/l respectively. Sewage treatment involves screens, grit removal, storm sewage treatment, primary settling, biological filters, and sludge treatment. Storm overflows are discharged into a 2 million gallon tank and effluent from this tank overflows on to 11 acres of under-drained land. Sludge is digested in heated tanks and digested sludge is disposed on sand drying beds, by irrigation of farm lands, and in earth banked drying beds. Gas from the digesters is used in power generation. Data on the performance and operation of all the processes employed are given. (DiFilippo-Texas)
W70-06081

THE EFFECT OF SYNTHETIC DETERGENTS ON SLUDGE DIGESTION AT RONDEBULT SEWAGE TREATMENT WORKS,
Rondebult Sewage Treatment Works, Germiston (South Africa).

P. H. v. d. Merwe.

Water Pollution Control, Vol 68, No 6, p669-672, Nov-Dec, 1969. 1 fig, 2 tab, 1 ref.

Descriptors: *Anaerobic digestion, *Detergents, *Sewage treatment, *Laboratory tests, *Neutralization, Facilities, *Waste water treatment.

Identifiers: Germiston (South Africa), *Amine residue, Synthetic, Mesophilic, Thermophilic.

The decline in gas production from sludge digestion at the Rondebult sewage treatment works has been noticeable in the last three years. A laboratory investigation revealed that the presence of relatively high concentration of synthetic detergents in the sludge was the main contributory factor. Synthetic detergent concentrations as high as 2.7 percent of dry solids were measured in the raw sludge. Laboratory-scale digesters were used for investigating the neutralization of the detergents by a residue of an industrial amine distillation process. The composition of the residue is not known, except that it contains long-chain di-alkyl amine in the ratio of two primary to one secondary amine. Studies utilizing both mesophilic and thermophilic digestion were conducted. The concentration of detergent in the mesophilic digester decreased from 3.9 to 1.3 percent of dry solids with an addition of 2.0 gm of residue/gm detergent. Although the thermophilic study was not concluded, it appears that thermophilic digestion offers no solution to the problems encountered in sludge digestion due to high concentrations of detergents. (Galwardi-Texas)
W70-06082

THE RECLAMATION OF POTABLE WATER FROM SEWAGE,
National Inst. for Water Research, Pretoria (South Africa).

G. J. Stander, and L. R. Van Vuuren.

Water Pollution Control, 1969, Vol 68, No 5, p 513-522, Sept-Oct 1969. 11 fig, 1 tab, 8 ref.

Descriptors: *Tertiary treatment, *Absorption, *Costs, *Potable water, Waste water treatment, Biochemical oxygen demand, Ammonia, Filtration, Nutrients, Chemical oxygen demand, Coliforms, Viruses.

Identifiers: *Floation, Chemical stabilization, Foam fractionation.

A pilot plant (1000 gal/hr) for the reclamation of potable water was operated using primary and secondary sewage treatment plant effluents. Pilot plant processes included flotation, ammonia stripping, chemical stabilization, and filtration, foam fractionation, chlorination and carbon adsorption. Primary clarifier and humus tank (secondary clarifier following trickling filters) effluents were separately applied as pilot plant influents. Various water quality parameters including am-

monia, organic nitrogen, total nitrogen, phosphate, alkyl benzene sulphonate (ABS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), Esch. coli, and Polio I virus were followed through the system and process removal curves are provided for each parameter. Results indicated the pilot plant effluent chemical and biological quality to be well within WHO ranges for potable water. Humus tank effluent, however, resulted in a water consistently high in nitrate-nitrogen. Costs were projected for a 1 mgd plant and amounted to 21.5 cents/1000 gal and 27.0 cents/1000 gal for treatment of humus tank effluent and primary clarified effluent, respectively. (Sorber-Texas)
W70-06083

PHOSPHATE RELEASE IN ACTIVATED SLUDGE PROCESS,

Virginia Polytechnic Inst., Blacksburg, Va.
Clifford W. Randal, Duane W. Marshall, and Paul H. King.

Journal of Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA2, Proc. paper 7223, p 395-408, April 1970. 7 fig, 4 tab, 28 ref.

Descriptors: *Phosphorus, *Activated sludge, *Anaerobic conditions, *Oxidation-reduction potential.

Identifiers: Phosphorus uptake, Phosphorus release.

The mechanisms of soluble phosphate uptake and release by activated sludge are the subject of considerable controversy. This laboratory experiment, utilizing batch tests with a volume of 3.5 l and approximately 2000 mg/l solids concentrations, found an uptake of phosphorus greater than the carbon to phosphorus ratio of 100:1 generally accepted for activated sludge: averaging more than twice this ratio. The extent of uptake varied directly with initial phosphate concentration which was between 56 mg PO₄/l. Approximately 7 hours were required for stabilization of the initial 350 mg/l COD to a residual of approximately 90 mg/l COD. After stabilization of the COD soluble phosphate was released back into solution and varied between 9% and 21% of total uptake over a 4 hour period. Under controlled anoxic conditions, pH approximately 8.5, release of soluble phosphate was rapid and averaged 56.2% within 90 minutes. Chemical suppression of phosphate release under anoxic conditions was accomplished by the addition of sulfate salts. Magnesium sulfate was effective with the inhibition of phosphate release a direct function of the amount of MgSO₄ added, 50% inhibition with a 2% solution; Sodium sulfate was not effective. A relationship between ORP and phosphate release was sought but not found. The results of the study indicated an initial uptake of phosphorus greater than the accepted C/P ratio and the conclusions attribute cell lysis as the major cause of activated sludge phosphate release. (Morgan-Texas)
W70-06084

SEWAGE TREATMENT IN RURAL AREAS,

T. G. Faulkner.

Water Pollution Control Vol 68, No 4, p 443-448, July-Aug., 1969.

Descriptors: *Rural areas, *Waste water treatment, Pumping, Sludge treatment, Sludge disposal, Design standards, Operations, Sewage districts.

Identifiers: Main drainage.

In 1944 the Rural Water Supplies and Sewerage Act (England) placed a charge on the rural district as a whole to provide needed financial assistance for construction of sewage works. The question of regional main drainage or drainage for one or two villages together can be answered only after engineering studies are made. Pumping plants should be selected from engineering considerations regardless of price since pumps will operate with minimum attention in rural areas. Treatment works should be designed for minimum labor. Trade effluents and storm flows must be added to the

domestic flows for design. Septic tanks, biological filters, or packaged plants may be used for treatment. Sludge from small works can best be treated at a central point. Operation and control should be done by traveling gang or by inspectors in cases where a resident manager is not justified. (Berrill-Texas)
W70-06085

SURVEY OF WASTE WATER RATES AND CHARGES,

Sewer Dept., Lafayette, La. Utilities System.

E. E. Dupre.

Journal Water Pollution Control Federation, Vol 42, No 1, p 33-43, Jan 1970. 1 tab.

Descriptors: *Costs, *Rates, *Sewers, Taxes, Waste water treatment, Population.

Identifiers: *Charges, *Expense, Revenue.

The Lafayette, Louisiana, Sewer Department served three cities in each state of the U.S. to determine the types and basis for waste water rates and charges applied. Seventy-two cities responded. A tabulation of these data is included. The data include: location, charges for extention of sewers, population, terrain, type of waste water treatment, influent BOD, average BOD removal, number of personnel, sources and amounts of revenue, payroll costs, and current sewer rates. (Bishop-Texas)
W70-06086

WATER AND POLLUTION CONTROL IN THE IRON AND STEEL INDUSTRY, WITH SPECIAL REFERENCE TO THE SOUTH AFRICAN IRON AND STEEL INDUSTRIAL CORPORATION,
Pretoria Steel Works (South Africa).

J. J. Heynike, and F. V. Von Reiche.

Water Pollution Control, Vol 68, No 5, p 569-573, Sept.-Oct 1969. 1 fig, 4 tab, 2 ref.

Descriptors: *Water reuse, *Industrial waste, *Waste treatment, Dissolved solids, Sprinkler irrigation.

Identifiers: South Africa, Iscor works, *Steel industry wastes.

Due to fresh water shortages the Pretoria and Vanderbijlpark steel works of Iscor (South Africa) draw 1100 to 1250 gallons water/short ton of steel produced while adhering to an effluent standard of 1200 mg/l dissolved solids. Several water re-use schemes employed to minimize water usage are described including recycle of blowdown from one process as make-up for another. Processes such as acid pickling and blast furnace gas washing impart or high inorganic dissolved solids content to water. To avoid expensive demineralization these highly polluted waters are acceptable for consumptive uses such as slag granulation, or as irrigation water for crops. Six to eight inches per year of gas-scrubbing effluent from blast furnaces may be spray-irrigated on Eragrositis Curvula grass imparting 480-600 pound N per acre per year. The individual methods of disposal of effluent from seven main production units are described. Final effluent standards and actual effluent analysis are given. The cost of waste treatment is 1 1/2 to 2 percent of the overall costs of a steel mill. (DiFilippo-Texas)
W70-06088

CONTROL OF ACTIVATED SLUDGE BY MEAN CELL RESIDENCE TIME,
California Univ., Berkeley. Sanitation Engineering Research Lab.

David Jenkins, and Walter E. Garrison.

Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1905-1919, Nov 1968. 6 fig, 2 tab, 15 ref.

Descriptors: *Kinetics, *Activated sludge, *Chemical oxygen demand, *Waste water treatment, Design, Operation, Microorganisms, Nitrification.

Identifiers: *Menad equation, Volatile suspended solids (VSS), Pomona, California.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

A rational description of activated sludge process is presented, with demonstration of the way in which the effect of process variables can be predicted and design and control principles improved. Using a modified Monod equation, substrate removal rate and mean cell residence time based on chemical oxygen demand removed per pound of volatile suspended solids are calculated. Basing activated sludge design parameters on mean cell residence time the authors show that the data from the Pomona Water Renovation Plant in California compare favorably with other studies. Results show that substrate removal rate and mean cell residence time are kinetically rational design, control, and operating parameters and are related. A standard rate of 0.2 0.5 lbs BOD/day/lb VSS compared to a mean cell residence time of between 5 - 15 days. A sample calculation is included. (Hancuff-Texas) W70-06089

INCREASED LOADINGS ON DIGESTERS WITH RECYCLE OF DIGESTED SOLIDS, Illinois Univ., Urbana.

John T. Pfeffer.

Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1920-1933, Nov. 1968. 10 fig, 1 tab, 10 ref.

Descriptors: *Anaerobic digestion, *Operation, Digestion, *Waste water treatment, Methane bacteria.

Identifiers: *Solids retention time, *Loading rate, Recycle, Volatile solids, Acid fermentation.

Recycle of digested solids from the secondary digester back to the primary digester offers a means of increasing the loading rates with a dilute feed sludge while maintaining the solids retention time (SRT) necessary for stabilization. The increase in SRT associated with recycle produces an increase in the reduction of volatile solids, an increase in total gas production, and a more stable digestion system. Controlling factors are the concentration of solids in return cycle sludge and the ratio of the desired solids retention time to the liquid retention time. A specific example is cited in which the recycle of digested sludge increased the volatile solids destruction from an average of 44,000 lbs/day to 53,000 lbs/day. The additional solids destruction also was reflected in the reduction of the volatile content of the digested sludge from 59.4% to 53.5% during recycling. Methane fermentation of the volatile acids has been found to be the rate limiting step in high rate digestion for 10-15 day systems, acid fermentation after 15 days. (Hancuff-Texas) W70-06090

APPLICATION OF DIGESTION THEORY TO DIGESTER CONTROL, Iowa Univ., Iowa City.

Richard R. Dague.

Journal Water Pollution Control Federation, Vol 40, No 12, p 2021-2032, Dec 1968. 3 fig, 3 tab, 33 ref.

Descriptors: *Anaerobic digestion, *Control, *Digestion, Sludge treatment, Methane bacteria, *Waste water treatment, Operations, Hydrogen ion concentration.

The successful operation of anaerobic digestion systems depends on the control of bacteria, food, contact time, temperature, pH, and toxic materials. Stabilization of raw sludge depends on the production of methane gas through an assembly-line-like process involving acid forming and methane forming bacteria. The methane producing assembly line can be operated at peak efficiency and stability by: (1) controlling the bacterial population which here refers to methane formers, (2) providing for uniform feeding with respect to both time and consistency, (3) adequate contact time determined through the solids retention time (SRT) not simply the hydraulic retention time, (4) uniform temperature which should be provided through adequate mixing and maintained at approximately 95 degree

F, (5) suitable pH not dropping below pH of 6.5, and (6) eliminating excessive concentrations of toxic materials. This paper presents a discussion of the basic requirements and indices of digestion and the manner in which the basic requirements should be applied to digester control. (Hancuff-Texas) W70-06093

HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL,

Iowa State Water Resources Research Inst., Ames. Richard R. Dague, Wayne L. Paulson, and Kenneth J. Kline.

Available from the Clearinghouse as PB-191 248, \$3.00 in paper copy, \$0.65 in microfiche. Iowa State Water Resources Research Institute Report No. 69-2, Iowa University, 1969. 37 p, 13 fig, 10 tab, 7 ref. OWRR Project A-022-IA.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.

Identifiers: Feedlot wastes, Waste management.

The hydrologic factors that require consideration when designing systems for the control of cattle feedlot runoff are considered. A discussion of several methods of controlling feedlot wastes is presented. Significant conclusions: (1) A significant reduction in water pollution from cattle feedlot runoff can be accomplished by employing relatively simple and inexpensive runoff control facilities. The size of such facilities can be determined using established techniques for hydrologic and water quality analyses; (2) Using procedures similar to those described herein, it would be possible for control agencies to establish the minimum size of runoff control facilities for each region or major stream basin for each of several possible ultimate runoff disposal practices; and (3) Caution should be exercised in applying the term 'population equivalent' to cattle feedlot wastes. Any use of the term must consider the fact that the fraction of the total waste that enters water is extremely variable from one location to another and is heavily dependent upon the quantity and time variation in precipitation, the cattle density on the feedlot, and the topographic characteristics of the lot. W70-06095

SECONDARY TREATMENT OF POTATO PROCESSING WASTES - FINAL REPORT,

Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.

Kenneth A. Dostal.

Federal Water Pollution Control Administration Technical Project Report No FR-7, July 1969. 63 p, 10 fig, 10 tab, 14 ref, append.

Descriptors: *Sewage treatment, *Potatoes, *Waste water treatment, *Idaho, Anaerobic digestion, Aerobic treatment, Oxygen demand, Biochemical oxygen demand, Ammonia, Nitrogen.

Identifiers: Potato processing wastes, Snake River (Idaho).

Three pilot lagoons were used to study potato waste treatment from October 1966 through June 1968. One of the lagoons received primary clarifier effluent and was operated as a surface-aerated, aerobic unit. A second pond also received clarifier effluent but was operated as a completely-mixed, covered anaerobic unit. The effluent from the anaerobic unit was pumped into a third pond which contained a surface aerator. Hydraulic and organic loadings were varied to yield a variety of results. Both systems are economically feasible; the choice would depend upon local costs and conditions. The BOD in these potato wastes was reduced 90 percent or more. No chemical additions were necessary for either pH control or inorganic nutrient adjustment. (Knapp-USGS) W70-06161

CHEMICAL METHODS FOR THE REMOVAL OF NITROGEN AND PHOSPHORUS FROM SEWAGE PLANT EFFLUENTS, Wisconsin Univ., Madison. Hydraulic Lab.; and Wisconsin Univ., Madison. Sanitary Lab.

Gerard A. Rohlich.

Algae and Metropolitan Wastes, Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Technical Report SEC TR W-61-3, p 130-135, 1961. 3 fig, 7 ref.

Descriptors: *Phosphorus compounds, *Nitrogen compounds, *Sewage treatment, *Sewage effluents, Eutrophication, Pollution abatement, Water pollution control, Water pollution sources, Diatomaceous earth, Electrolysis, Chemical precipitation, Sanitary engineering, Wisconsin, Ion exchange, Aeration, Nitrates, Ammonia, Organic compounds.

Identifiers: *Chemical processes, *Nutrient removal, Organic nitrogen compounds, Guggenheim process, Ferrous sulfate, Ferric sulfate, Cupric sulfate, Aluminum sulfate, Process design, Madison (Wis), Pilot plant studies, Laboratory studies, Strong base anionic exchangers, Amberlite IR-120, Amberlite IRA-410, Nalcite SAR, Nalcite HCR.

Various chemical methods have been proposed for removal of plant nutrients in secondary sewage treatment plant effluents. Phosphorus compounds can be removed by electrolytic treatment or chemical precipitation. Since soluble nitrogenous compounds are inefficiently removed by precipitation, ion exchange methods offer great potential. Studies of phosphate coagulation were conducted employing ferrous sulfate, ferric sulfate, cupric sulfate, diatomaceous earth, and aluminum sulfate. Cupric sulfate precipitation forms floc which cannot be satisfactorily settled. Summarized, data indicated that approximately 200 milligrams alum/liter effectively removes 96-99% soluble phosphates, about 85% biologically oxidizable organic compounds, and some 68% organic nitrogen compounds. Process requires 6- to 10-fold more coagulant than is required for clarification of surface waters for potable water supply, with similar increases in cost. Recovery and purification of aluminum floc may reduce cost by 80%. Strong base ion exchangers and nuclear sulfonic cation exchangers, both regenerated with common salt, satisfactorily remove nitrate- and ammonia-nitrogen, respectively. Latter can also be air-stripped in towers packed with Raschig rings. Two design processes are presented for removal of nitrogen and phosphorus from sewage effluents where ammonia is removed by cation exchange or by forced draft aeration. (See W70-04506) (Eichhorn-Wisconsin) W70-06214

STUDY OF POWDERED CARBONS FOR WASTE WATER TREATMENT AND METHODS FOR THEIR APPLICATION.

West Virginia Pulp and Paper Co., Covington.

Available from the Clearinghouse as PB-191 538, \$3.00 in paper copy, \$0.65 in microfiche. Water Pollution Control Research Series, September, 1969. 34 p, 6 tab, 15 fig, 9 ref. FWPCA Project 17020DNQ-9/69, Contract 14-12-75.

Descriptors: *Waste water treatment, Municipal wastes, *Activated carbon, *Adsorption, Effluents, *Pores.

Identifiers: Total organic carbon, Adsorption rate, Adsorption capacity, Roanoke (Va), Secondary effluents.

Eleven commercial and experimental powdered activated carbons were subjected to an intensive laboratory evaluation of their physical and adsorptive properties to select those best suited to treating municipal waste water and to gain insight into properties important for this application. Measurements were made of TOC (Total Organic Carbon) adsorption isotherms from Roanoke, Virginia municipal secondary effluent, pore structure, BET surface area, molasses value, decolorizing index,

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iodine value, real density, suspendability, and apparent density. Correlations were made between capacities for adsorbing organic impurities from municipal secondary effluent, as measured by TOC adsorptive capacities, and carbon properties such as iodine value, molasses decolorizing index and pore structure. Aqua Nuchar and Hydrodarco were clearly superior to other commercial grades tested in TOC adsorptive capacity per unit cost. The coal-base experimental carbons, pulverized Nuchar WV-L and Nuchar WV-W, were indicated by the suspendability test to be more easily removed than other carbons. Among many pore structure parameters compared, surface area in pores greater than approximately 14 Angstroms in radius was found to give the best correlation with TOC capacity. However, the correlation was not perfect, the correlation coefficient being 0.91. TOC adsorptive capacity was indicated reasonably well by the decolorizing index test. Here, correlation coefficients in the 0.80's were obtained. It is suggested that the best carbon for adsorbing organics from municipal wastes have a broad spectrum of pore sizes. Particle size of the powdered carbons was found to strongly affect the rate of adsorption. Aqua Nuchar, Hydrodarco, and pulverized Nuchar WV-L are recommended for further study. W70-06264

THE CENTRIFUGAL RECOVERY OF WOOL GREASE,
C. H. Anderson.
Wool Science Review, Vol 37, p 23-36, October 1969. 7 ref, 11 fig.

Descriptors: *Centrifugation.
Identifiers: *Recovery (Waste), *Wool grease, *Wool scouring, Textile mill wastes.

Recovery of wool grease from scouring liquors is important to the wool industry for two reasons: (1) it is profitable; (2) pollution by putrefiable fleece components is prohibited in many places. Scouring liquors will separate into 3 phases: (1) upper phase - mainly grease, (2) intermediate phase - retains aqueous detergent solution plus a small amount of wool grease, (3) lower-level heavy dirt particles. The process described has three centrifugations. The first has the primary objective of removing dirt from the liquor and producing a wool grease concentrate containing 15 plus or minus 5 percent at maximum yield. The primary conglomerate from the first centrifugation is centrifuged to remove some of the fine sludge remaining after primary separation and to concentrate the product to a grease content of at least 70%. The purifier centrifuge removes the remaining water and fine sludge particles from the secondary conglomerate. The best conditions for scouring are also the best for wool grease recovery, the essential thing being to remove as much grease as possible in the first hot bowl. (Robinson-North Carolina State Univ) W70-06265

PROCESS WATER AND PROBLEMS ASSOCIATED WITH TEXTILE EFFLUENT,
F. H. Slade.
Textile Manufacturer, Vol 94, p 14-18, 1968. 10 fig.

Descriptors: *Coagulation, *Supply water, *Centrifugation, Sedimentation, Flocculation, Separation techniques, Water softening, Ion exchange.
Identifiers: Aluminum sulphate, Sedimentation tanks, Continuous sand filter, Pressure filters.

A large portion of water intake may be effluents of other manufacturers and will contain many substances produced by them. All contaminants produce special treatment problems which are further complicated by the probability of many unit processes discharging their waste products at the same time. Water received from public supply will not require treatment other than as demanded by special processes. Basically, the method of purification is the same for all waters with the variables of character and amount of contained impurities in-

fluencing details of plant design and chemical treatment necessary. The impurities must first be coagulated to permit removal by filtration or by sedimentation followed by filtration. Aluminum sulphate is the most common coagulate: a low pH responds well to coagulation. The purpose of sedimentation is to remove the maximum amount of turbidity from the water and so reduce the filter loading. Clarification may also be achieved by centrifugation. Waters may be clarified in gravity or pressure filters. The use of a water-softening plant enables many textile processes to be carried out irrespective of locality. The ion exchange method is the most efficient for producing soft water. (Robinson-North Carolina State Univ) W70-06266

MECHANICAL TREATMENT OF EFFLUENT (IN RUSSIAN),

L. V. Krasovskii.
Tekstil'Naia Promyshlennost, Vol 27, No 10, p 61-62, 1967.

Descriptors: *Screens.
Identifiers: *Sand traps, *Settling tanks, *Textile mill wastes, Mechanical treatment, Fiber wastes, Dyestuffs.

The use of screens, sand traps, and settling tanks in the treatment of textile-processing effluent containing fiber bits of fabric, insoluble particles of dye, and chemical auxiliaries is discussed. (Livengood and Robinson-North Carolina State Univ) W70-06267

INDUSTRIAL MEASURES FOR THE PURIFICATION OF AIR AND WATER (IN GERMAN),
M. Kehren.

Textilveredlung, Vol 1, No 5, p 219-227, 1966.

Descriptors: *Pilot-plant.
Identifiers: *Mechanical filtration, *Electrostatic precipitation, *Air cleaners.

The large-scale developments and the plant at Farwerke Hoechst are described. Mechanical filtration and electrostatic precipitation are used in air cleaners. A pilot-scale water treatment plant has been used to develop a full-scale effluent and water plant dealing with 24,000 cu m per day. (Livengood and Robinson-North Carolina State Univ) W70-06268

IN PLANT PROCESS CONTROL FOR ABATEMENT OF POLLUTION LOAD OF TEXTILE WASTES,

S. V. Ganapati.
Environmental Health (India), Vol. 8, No. 3, p 169-173, 1966.

Descriptors: Biochemical oxygen demand, Detergents, Heat exchangers.
Identifiers: *Starch, *Sizes (Slashing), *Polyvinyl alcohol, *Carboxymethylcellulose, Waste heat recovery, Dyehouse wastes, Acetic acid, Desizing, Textile mill wastes.

The procedures for the reduction of waste at a textile mill are discussed. It is possible to reduce the volume and strength of the waste by recovery of certain salvageable substances and to recover much waste heat from the processes. A significant quantity of pollution results from the desizing process. This can be reduced by utilizing chemicals with a lower BOD, such as synthetic sizing agents. (C. Livengood and Robinson-North Carolina State Univ) W70-06269

WASTE DISPOSAL SYSTEMS - HOW THEY SHAPE UP TODAY,

R. W. Pinault.
Textile World, Vol. 114, p 100-110, June, 1964. 9 figures

Descriptors: *Sewage disposal, *Oxidation lagoons, *Aeration flocculation, Chemical precipitation.

Identifiers: *Chemical treatment, Dyehouse wastes, Slashing wastes, pH treatment, Biosorption process, Textile mill wastes.

Four basic approaches can be used to improve plant effluent. Chemical treatment is the most expensive and depends on flocculation and precipitation. This process neutralizes pH and traps most of the color in the sludge. The second approach is a full-scale sewage disposal plant which needs some adaptation before handling mixed wastes. The third method is an oxidation pond. This process may meet local treatment requirements. However, it is only minimum treatment. The ambient temperature must be warm enough to promote bacterial growth. The last method is an aerated lagoon which is a biosorption process. Air is added to a lagoon system by mechanical agitation or by compressed pumping. This is inexpensive and does not provide for sludge disposal. Some plants use flue gas to reduce pH and thus makes waste disposal easier. Surfactants of the branched-chain type of alkylbenzene sulfonates have almost completely replaced soaps in many textile processes. Soaps have been problems because their foams were nearly indestructible. (Robinson-North Carolina State Univ) W70-06271

PRECIPITATION OF DIRECT DYE BY FERROUS SULFATE,

Society of Chemical Industry, Tokyo (Japan).
H. Iida.

Kogyo Kagaku Zasshi, Vol. 67, p 210-213, 1964.

Descriptors: *Chemical precipitation.
Identifiers: *Precipitation, *Direct dyes, *Ferrous sulfate, Dyestuffs, Clarification, Dyehouse wastes.

In order to obtain basic data for the clarification of waste water containing dyes, experiments on the precipitation of five direct dyes in aqueous solution were carried out by the addition of ferrous sulfate. The purified dye was dissolved in water and ferrous sulfate. Solution was added to the solution under various conditions. The precipitate formed was separated by centrifugation and the remaining dye in the filtrate was determined by colorimetry. (Livengood and Robinson-North Carolina State Univ) W70-06272

POLLUTION FACTORS AND TREATMENT OF TEXTILE WASTE WATERS,

For primary bibliographic entry see Field 05B.
W70-06273

STREAM POLLUTION AND EFFLUENT TREATMENT, WITH SPECIAL REFERENCE TO TEXTILE AND PAPER MILL EFFLUENTS,
L. Klein.

Chemistry and Industry, p 866-873, 1964.

Descriptors: *Sedimentation, *Flocculation, *Activated sludge, Legislation, Biological treatment, Lagoons, Anaerobic digestion.

Identifiers: *Textile mill wastes, *Paper mill wastes, *Percolating filters, Clarification, Stream pollution, Effluent treatment, Physical treatment, Chemical treatment.

The polluted condition of the river Irwell and other rivers in Lancashire and recent legislation to control pollution are discussed. General measures are indicated that can be taken by industry to reduce the volume and strength of waste waters, including process changes, re-use of waste waters, and recovery of by-products. The polluting materials present in waste waters from pulp and paper mills and from textile mills, the effects of the waste waters on receiving streams, and methods of treating these waste waters by physical, chemical and biological processes are all discussed. A bibliog-

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

raphy of 29 references is appended. (Livengood and Robinson, North Carolina State Univ) W70-06274

WASTE WATER IN THE TEXTILE INDUSTRY,
M. Kehren.
Melliand Textilberichte, Vol. 43, p 1217-1222, 1962.

Descriptors: *Sedimentation, *Activated sludge.
Identifiers: *Niers process, *Turicit process, *Textile mill wastes, Chemical treatment, Mechanical treatment, Biological purification, Clarification.

The chemical and mechanical means of achieving biological purification and clarification of textile waste water by the following methods are discussed: by settling media, by activated sludge, and by the Niers and Turicit Methods of mechanical clarification preceding biological treatment. (Livengood and Robinson-North Carolina State Univ) W70-06275

WASH-WATER RECOVERY CUTS MERCERIZING COSTS,
R. W. Pinault.
Textile World, Vol. 106, p 107, February 1956. 2 figures.

Descriptors:
Identifiers: *Caustic, *Recovery (Waste), *Zaremba evaporator, Textile Mill wastes, Mercerizing wastes.

Fairforest Finishing Division of Reeves Brothers, Inc., recently put a Zaremba evaporator into use to reconcentrate Mercerizer wash water. The unit saves caustic and reduces alkalinity of the finishing plant effluent. The water treated contained 4-8% sodium hydroxide. The waste water is 506% less alkaline than before treatment by the Zaremba evaporator, and chemical treatment for neutralization is correspondingly less. The Mercerizer wash water is pumped through a hard-coal filter. After filtration, the weak caustic is pumped to a receiving tank, where it is then pumped into the stream chest of the Zaremba recovery system. In a heat-exchange process, the caustic is brought to a boil and discharges into the evaporating chamber. The flow of weak caustic into the stream chest and discharge of 40% caustic from the evaporator are automatic. (Robinson-North Carolina State Univ) W70-06276

TEXTILE WASTE PROBLEMS,
For primary bibliographic entry see Field 05A.
W70-06277

BEHAVIOR OF SULFIDES AND SULFUR DYES IN WASTE WATER,
M. Kehren, and H. Denks.
SVF Fachorgan Textilveredlung, Vol. 12, p 138-153 and 492-498, 1957.

Descriptors: *Sulfides, Waste water treatment, Aeration, Carbon dioxide.
Identifiers: *Sulfur dyes, *Dyehouse wastes, Sodium sulfide, Hydrochloric acid, Precipitation.

In waste waters containing sulfides and sulfur dyes, sodium sulfide is removed by treatment with hydrochloric acid or mixture of carbon dioxide and air, followed by aeration. Almost insoluble sulfur dyes cannot be precipitated by aeration or carbon dioxide alone, but can be removed by treatment with mixtures of carbon dioxide and air. Soluble sulfur dyes can only be precipitated with salts of heavy metals at a pH 5.5. (Livengood and Robinson-North Carolina State Univ) W70-06278

SUPPLY TREATMENT AND DISPOSAL OF WATER IN THE DYEHOUSE,
R. W. Richardson.

Journal of the Society of Dyes and Colourists, Vol. 73, p 485-491, 1957. 1 ref.

Descriptors: *Water supply, Calcium, Magnesium, Iron, Alkalinity, Acidity, Ponding, Flocculation, Water softening, Ion exchange, Zeolites, Water analysis, Temperature, Detergents, Neutralization, Biochemical oxidation demand, Costs, Economics.
Identifiers: *Dyehouse wastes, *Chemical purification, Aluminum hydroxide, Bacterial filter bed.

The three sections of this paper discuss (1) supply, (2) treatment and (3) disposal. The water supplies in England can be divided into three types, each having its particular advantages and disadvantages. Few dyehouses are located so conveniently that some sort of purification is not necessary. The chief impurities in a water supply from the point of view of use for textile purposes are particulate and colloidal matter colour, 'hardness salts' and other interfering metal ions, acidity, and alkalinity. Clarification may be brought about by ponding, and many times aluminum hydroxide must be added as a flocculation. Two main types of water softening systems are now used: ion exchange and chemical purification. Water analysis is discussed in connection with water softening. Dyehouse effluents can be divided into three main types: wool, cotton, and mixed man-made fiber wastes. The differences in character are due mainly to the various preparatory processes carried out. The polluting effect of a textile waste results from the high organic matter content, which acts by depriving the stream of its dissolved oxygen. The temperature of an effluent also has as important an effect as the polluting waste itself. A rise in the temperature of a stream reduces its capacity to hold dissolved oxygen and at the same time increases the rate at which biological deoxygenation takes place. (Robinson-North Carolina State Univ) W70-06279

WASTE WATERS FROM THE WOOL INDUSTRY (IN RUSSIAN),
For primary bibliographic entry see Field 5B.
W70-06280

BLEACHERY AND DYEHOUSE WASTE STUDIES,

Cannon Mills Co., Kannapolis, N.C.
John L. Brown, Jr.
American Dyestuff Reporter, Vol. 44, No. 12, p 385-386, 1955.

Descriptors: Heat exchangers.
Identifiers: *Bleaching wastes, *Dyehouse wastes, Segregation, Textile mill wastes, Acidic wastes, Alkaline wastes, Bleaching.

A study of Cannon Mills' waste problems showed the following results (1) standardization of bleaching processes reduces waste strength and lowers cost. (2) Re-use of cleaner water lowers water consumption about 10%. (3) Fine screens installed ahead of heat exchangers remove fibers and increase efficiency. (4) It is economically feasible to treat and refilter a sizeable quantity of water. The segregation of three categories of wastes was found feasible: (1) acid, (2) strongly alkaline, and (3) mildly alkaline wastes. In the proposed treatment plan, the first two categories will be treated separately and added to the remaining industrial waste and domestic sewage for final treatment. Storage of the acid and strongly alkaline wastes allows seven-day operation of the treatment plant. (Sheffield-North Carolina State Univ) W70-06281

TEXTILE-WASTE TREATMENT IN TEXAS,
Texas State Dept. of Health, Austin. Bureau of Sanitary Engineering.
D. F. Smallhorst.
American Dyestuff Reporter, Vol. 44, No. 12, p 386-389, 1955. 8 tab.

Descriptors: *Domestic wastes, Coagulation, Chemical analysis, Lagoons, Oxidation lagoons.

Identifiers: *Indigoid dyes, *Dyehouse wastes, *Finishing wastes, *Slashing wastes, Textile mill wastes.

Over several years the Texas Textile Mill attempted to find a type of treatment for textile waste permitting it to be further purified in a domestic sewage plant without affecting the plant's operating efficiency. Recommendations on coagulation, flow studies, chemical analysis, and measurements of waste volume were made. Wastes were grouped into four categories: indigo, dyehouse, finishing, and slashing wastes. A lagoon for dye waste gave remarkable clarification and emitted little hydrogen sulfide odor. Now the mill waste is seeded with domestic sewage and put in oxidation ponds where organisms remove organic matter. (Sheffield-North Carolina State Univ) W70-06282

BIOLOGICAL TREATMENT OF MIXTURES OF HIGHLY ALKALINE TEXTILE-MILL WASTES AND SEWAGE,

Cone Mills Corp., Greensboro, N.C.
R. H. Souther, and T. A. Alspaugh.
American Dyestuff Reporter, Vol. 44, No. 12, p 390-395, 1955. 1 figure, 10 tables, 7 references.

Descriptors: *Trickling filters, *Activated sludge, Pilot plants, Alkalinity, Biological treatment, Domestic wastes.
Identifiers: Textile mill wastes.

Results of a pilot-plant study by Cone Mills show that a mixture of up to 40% highly alkaline effluent with 60% domestic sewage can be biologically treated without pretreatment. The most successful method tested employed a high-rate trickling filter and activated sludge both of which were acclimated to highly alkaline waste. BOD removal averaged 93%; pH was lowered from 10.0-11.4 to 7.9-8.5; 95% of suspended solids was removed; the final effluent was odorless and colored with a tinge of yellow. Shock loads did not destroy the system, but at pH above 11.4 efficiency of operation dropped. (Sheffield-North Carolina State Univ) W70-06283

DESIGN AND COST OF LIQUID - WASTE DISPOSAL SYSTEMS,
Alabama Univ., University. Natural Resources Center.

Charles D. Haynes, and David Grubbs.
Available from the CLEaringhouse as PB-191 535, \$3.00 in paper copy, \$0.65 in microfiche. Report 692, Natural Resources Center, University of Alabama, Dec. 1969. 110 p, 21 ref, 36 fig, 2 tab. OWRR Project B-019-ALAS (1).

Descriptors: *Liquid wastes, *Water disposal, Deep wells, Computer programs, Computer models.
Identifiers: *Texas curve.

An method of liquid-waste disposal is injection into subsurface reservoirs. The cost of disposal is an overriding consideration in determination of the feasibility of deep-well disposal. Physical and engineering limitations in the design of the system are considered. Also considered is the capital investment in the treatment plant, the pipeline, and the disposal well. A third section is a computer program affording a highly flexible procedure for design and estimation of deep-well disposal systems. Four combinations of design procedures are offered: (1) Steady-state flow question in combination with the Texas curve of average treatment plant costs; (2) Pressure buildup subroutine in combination with the Texas curve to obtain plant cost; (3) Steady-state flow equation combined with PLANT subroutine for treatment plant cost; and (4) Plant buildup subroutine combined with PLANT subroutine. A print-out of the program is included. (Grossman-Rutgers) W70-06311

THE PROBLEM OF AGRICULTURAL POLLUTION IN WATER TREATMENT,
Pawtucket Water Dept., R.I.
John A. McManus, and Albert A. Zalfa.
Journal of the New England Water Works Association, Vol. 83, No. 4, p 311-321, Dec. 1969. 11 p, 2 tab, 2 fig.

Descriptors: *Water pollution sources, *Animal wastes, *Fertilizers, Farm wastes, Water pollution treatment, Legal aspects.

Identifiers: *Pawtucket (Rhode Island).

The main concern of the Pawtucket, Rhode Island water supply system is the problem of pollution due to farmers using animal wastes for fertilizer. Due to the lack of large reservoir at the lowest end of the drainage basin feeding the treatment plant, the results of the animal wastes on the fields are severe at the point of treatment. The drainage and the seasonal usage of the water supply system are described: The pollution problem is in part attributed to one cattle company which hauled their waste material into the basin and deposited the solid and liquid wastes in great quantities. Because of the lack of dilution or detention time, high bacterial levels resulted. A schematic diagram of the water treatment plant is shown and its capabilities are described. The problem is that existing state law does not allow the prohibition of fertilizing agricultural land with animal wastes, even if such methods result in water pollution. (Grossman-Rutgers)

W70-06314

5E. Ultimate Disposal of Wastes

HYDROGEOLOGIC INFORMATION ON THE GLORIETA SANDSTONE AND THE OGALLALA FORMATION IN THE OKLAHOMA PANHANDLE AND ADJOINING AREAS AS RELATED TO UNDERGROUND WASTE DISPOSAL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-05922

SEEPAGE AND SEEPAGE CONTROL PROBLEMS IN SANITARY LANDFILLS,
Los Angeles County Sanitation District, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W70-06011

FARM WASTES,
Netherlands Government Agricultural Waste Water Inst., Arnhem.
For primary bibliographic entry see Field 05D.
W70-06056

WASTE DISPOSAL FROM WATERCRAFT,
Cargo Carriers, Inc., Minneapolis, Minn.
For primary bibliographic entry see Field 05D.
W70-06070

MECHANICAL DEWATERING OF MIXED SLUDGES AT ANDOVER,
For primary bibliographic entry see Field 05D.
W70-06071

UNDERGROUND DISPOSAL OF ACTIVATED SLUDGE,
Dow Chemical Co., Midland, Mich.
E. S. Shannon.
Journal Water Pollution Control Federation, Vol 40, No 12, p 2059-2061, Dec 1968. 2 fig.

Descriptors: *Activated sludge, *Sludge disposal, *Deepwell, Industrial wastes, Injection, Injection wells, Wells, Waste water.
Identifiers: *Dow Chemical, *Midland (Mich.).

The deepwell disposal has been used successfully for many years by a chemical manufacturing plant at Midland, Michigan to dispose of unmarketable by-product chemicals, brines, and high BOD wastes. Since 1963 excess activated sludge from the plant's waste water treatment facility also has been injected into underground formations. The activated sludge disposal well system consists of a 100 ft diameter thickener, two sludge holding tanks, 1 sludge forwarding station, 4 high pressure pumps, and 2 disposal wells. In operation excess activated sludge at about 1.5% solids is pumped to the thickener where the concentration is increased to about 2.5% solids. Injection pressures are kept below levels that would cause fracture of receiving formations. (Hancuff-Texas)

W70-06077

DESIGN AND COST OF LIQUID - WASTE DISPOSAL SYSTEMS,

Alabama Univ., University. Natural Resources Center.

For primary bibliographic entry see Field 05D.
W70-06311

5F. Water Treatment and Quality Alteration

EFFECT OF ANTIBACTERIAL AGENTS ON MINE DRAINAGES, USE OF VISIBLE ANTIBACTERIAL AGENTS TO REDUCE POLLUTION BY MINE DRAINAGES,
MSA Research Corp., Evans City, Pa.
For primary bibliographic entry see Field 05G.
W70-05959

GUIDELINES AND CRITERIA FOR COMMUNITY WATER SUPPLIES IN THE DEVELOPING COUNTRIES.

Bureau of Water Hygiene, Rockville, Md.

Available from the Clearinghouse as PB-189 255, \$3.00 in paper copy, \$0.65 in microfiche. Environmental Control Administration, Bureau of Public Hygiene report, Washington, DC, 1969. 108 p.

Descriptors: *Water supply, *Standards, Municipal water, Water pollution control, Urbanization.

The report is a synthesis of ideas on guidelines and criteria developed from team surveys of community water supply programs in twelve developing countries, four of them in Asia and eighth in Latin America. The purpose was to examine AID operations in this field and identify those factors contributing to the development of successful projects as well as those hindering such development. Chapters are devoted to policies, laws and institutions, program planning, capital financing, manpower and training, technical standards, project development, contracts and construction, operation and maintenance, water utility management and developing public support.

W70-05975

MINIMUM DESIGN STANDARDS FOR COMMUNITY WATER SUPPLY SYSTEMS.

Federal Housing Administration, Washington, D.C.

Available from the Clearinghouse as PB-189 258, \$3.00 in paper copy, \$0.65 in microfiche. Federal Housing Administration Report No 751, Wash DC, July, 65, 76 p.

Descriptors: *Water supply, *Standards, Municipal water, Water treatment, Water pollution control, Sanitary engineering.

This study sets forth minimum design standards acceptable to FHA for water supply production, treatment, pumping, storage, and distribution facilities to serve properties offered as security for mortgage insurance. These minimum design standards apply to central water systems serving re-

sidential neighborhood developments and multifamily projects.
W70-05976

COUNTY BOARD OF HEALTH (GENERAL POWERS AND DUTIES).

NJSA sec 26:11-10 (i) (1964).

Descriptors: *New Jersey, *Administrative agencies, *Waste disposal, *Public health, Legislation, Regulation, Legal aspects, State governments, Local governments, Permits, Drainage, Waste water disposal, Environmental sanitation, Animals, Birds, Sewers, Sewage disposal, Septic tanks, Cesspools, Ultimate disposal, Garbage dumps, Landfills, Wastes, Waste dumps, Plumbing.

The county boards of health shall have the powers: (1) to aid in the enforcement of all laws applicable to the preservation of human life and health; (2) to charge a reasonable fee for licenses issuable under this chapter; (3) to insure sanitary conditions in all public buildings in the county; (4) to regulate the plumbing, ventilation and drainage of every building in the county and to require plans for such to be submitted for approval; (5) to prohibit or regulate any noxious businesses; (6) to regulate all dealers in bones, fat and animal offal and any establishments for boiling fat or greasemaking; (7) to regulate accumulations of manure or other decaying matter; (8) to regulate and control night soil scavengers and the cleaning of any privies, cesspools or sinks; (9) to regulate the cleaning of sewers and the dumping of garbage; (10) to provide for the filling of sunken lots that are repositories for stagnant waters; (11) to regulate and control the keeping or slaughtering of animals, birds and beasts. (Barnett-Florida)

W70-06020

THE RECLAMATION OF POTABLE WATER FROM SEWAGE,

National Inst. for Water Research, Pretoria (South Africa).

For primary bibliographic entry see Field 05D.
W70-06083

RAW WATER QUALITY CRITERIA FOR PUBLIC SUPPLIES.

Journal American Water Works Association, Vol 61, No 3, p 133-138, Mar 1969. 6 p, 10 ref, 2 tab.

Descriptors: *Water quality, *Potable water, *Water supply, *Water properties, Domestic water, Impaired water quality, Color, Hardness (Water), Mineralogy, Nitrates, Odor, Pesticide residues, Public health, Radioactivity, Standards, Turbidity, Water, Water analysis, Water purification, Water quality control, Water softening, Pollutants, Water pollution sources, Coliforms.

Prepared by the National Technical Advisory Committee on Public Water Supplies, this report lists raw-water quality criteria for potable water supplies. Distinction is made between permissible and desirable criteria. Permissible criteria are those which result in the production of minimally satisfactory water whereas desirable criteria exceed such minimum standards. Listed criteria govern: (1) color; (2) odor; (3) temperature; (4) turbidity; (5) coliform and fecal coliform organisms; (6) alkalinity; (7) ammonia; (8) arsenic, barium, cadmium, chromium (hexavalent), copper, chloride, cyanide, iron, lead, manganese, phenols, selenium, silver, sulfate, zinc and radioactive substances; (9) boron; (10) dissolved oxygen; (11) fluoride; (12) hardness; (13) nitrate plus nitrite; (14) pH; (15) phosphorus; (16) total dissolved solids; (17) uranyl ion; (18) carbon chloroform extract; (19) methylene blue active substances; (20) oil and grease; and (21) pesticides and herbicides. (Marsee-Florida)

W70-06193

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

5G. Water Quality Control

EFFECT OF ANTIBACTERIAL AGENTS ON MINE DRAINAGES, USE OF Viable ANTIBACTERIAL AGENTS TO REDUCE POLLUTION BY MINE DRAINAGES,

MSA Research Corp., Evans City, Pa.

Robert E. Shearer, and William A. Everson.

Available from the Clearinghouse as PB-191 215, \$3.00 in paper copy, \$0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-21, November 1969. 138 p, 35 fig, 42 tab, 19 ref, 2 append. FWPCA Grant 14010 EGJ.

Descriptors: *Acid mine water, *Water pollution treatment, *Bactericides, *Inhibitors, *Acid bacteria, Antibiotics (Pesticides), Water pollution control, Mine wastes, Water quality, Water chemistry, Biocontrol.

Identifiers: Acid-bacteria inhibition, Caulobacter.

The active agents in natural waters previously found to inhibit bacterial production of acid in streams were investigated in the laboratory, and inoculations of natural water previously found to be inhibitory were made, about 14,000 gallons each, to a worked-out mine in Pennsylvania. After the first inoculation, tests showed absence of inhibitory power in the water at the time it was collected, and the water used for the second test was similarly found to be only weakly inhibitory. Strains of Caulobacter were found in the natural inhibitory waters, and when adapted to acidic environments and concentrated in culture media, they induced inhibition of acid production. Other adapted strains of Caulobacters also induced inhibition. Some evidence was shown that Caulobacter inhibitors might move downstream. Four species of Streptomyces tolerated acidic conditions, and were effective against the acid-producing bacteria in test tube cultures and on solid media. (Knapp-USGS) W70-05959

OHIO RIVER SANITATION COMPACT.

Ohio Rev Code Ann secs 6113.01 thru 6113.04 (Page, 1953).

Descriptors: *Ohio, *Sanitary engineering, *Water pollution, *Ohio River, Legislation, Legal aspects, Interstate, River basin commissions, Interstate rivers, Water resources development, Interstate compacts, Rivers, Streams, Wastes, Municipal wastes, Sewage disposal, Sewage, Domestic wastes, Industrial wastes, Drainage, Watersheds (Basins), Drainage districts, Water pollution control.

Ohio hereby adopts the Ohio River Sanitation Compact. Other member states are Illinois, Indiana, Kentucky, New York, Pennsylvania, Tennessee, Virginia, and West Virginia. The purpose of the Compact is to foster cooperation in the control and abatement of pollution from the rivers and streams in the Ohio River Basin. The guiding principle of this compact is stated to be that pollution by sewage or industrial wastes originating within a signatory state should not adversely affect the uses of the interstate waters. The Ohio River Valley Sanitation District and the Ohio Valley Water Commission are established by this compact. The composition, procedures, and powers of the Commission are set forth. Among the duties of the Commission are the study of pollution problems within the District, and the recommendation of uniform legislation dealing with these problems. The Commission may, after conducting appropriate hearings, order any person or municipality to terminate discharge of pollutants into interstate waters within the District. (Casey-Florida) W70-06018

BEALS V ROBERTSON (DISCHARGE OF MINE WATER INTO A NATURAL WATERCOURSE).

356 Pa 348, 52 A2d 316-317 (1947).

Descriptors: *Watercourses (Legal), *Flow control, *Mine drainage, *Pennsylvania, Water conveyance, Ditches, Legal aspects, Judicial decisions, Water law, Drainage, Surface drainage, Non-navigable waters, Natural flow doctrine, Natural use, Reasonable use, Mine water, Mine wastes, Relative rights.

Plaintiffs' land is lower than defendants' land, and the two are separated by an intervening parcel of land. Water discharged from a coal mine owned by defendants flowed in its natural course until it reached an abandoned ditch beside a township road. The water flowed in the ditch until it reached another natural watercourse which carried the water onto plaintiffs' land. Plaintiffs sought to enjoin defendants from discharging mine waters which reached plaintiffs' land. The court, affirming the trial court decree for defendants, held that owners of the upper land could not make new channels, nor concentrate and increase the flow of waters by artificial means, but such landowners had the right to have the water flowing from their land discharged into a natural watercourse upon the lower land. Furthermore, such owners could increase the flow through the natural and reasonable use of their land. (Powell-Florida) W70-06021

RYALL V WATERWORKS IMPROVEMENT DISTRICT NO3 (INJUNCTION SOUGHT TO STOP CONSTRUCTION OF TREATMENT PLANT).

445 SW2d 883-884 (Ark 1969).

Descriptors: *Arkansas, *Treatment, *Remedies, *Property values, Judicial decisions, Water pollution, Legal aspects, Competing uses, Local governments, Deep wells, Sewage treatment, Relative rights, Administrative agencies, Construction.

Identifiers: *Injunctions (Prohibitory), Nuisance.

Appellants sought an injunction against the Commissioners of the Waterworks Improvement District No. 3 to stop the construction of an oxidation treatment plant for sewage. Appellants contended that the oxidation plant would be a nuisance and expressed fear that the values of their property would depreciate. One appellant feared it would affect his deep-well system. Another testified she had lost sales of her property due to the proposed location of the plant. The lower court refused to grant the injunction. The appellate court affirmed, holding that there were no facts presented which established that the plant would constitute a nuisance. The fear of what may happen is not a sufficient ground for obtaining an injunction. A prohibition is allowed under Arkansas law only when the preponderance of the testimony shows that the activity is certain to be a nuisance. (Barrett-Florida) W70-06022

STATE AND FEDERAL AID--COMMON SEWER DISTRICTS.

Mo Ann Stat secs 204.200 thru 204.470 (Supp 1970).

Descriptors: *Missouri, *Sewage districts, *Sewage disposal, *Government finance, Waste disposal, Administration, Sewage, Domestic wastes, Municipal wastes, Sewers, Governments, Federal government, Local governments, State governments, Legal aspects, Legislation, Water law, Administrative agencies, Leadership, Cities, Financing, Costs, Rates, Grants, Cost repayment.

Under specified conditions the state may make grants to local governments for water pollution control. The State Water Pollution Board shall, consistent with federal provisions, administer such funds. Regulations are provided governing incorporation of common sewer districts and approval of incorporation by taxpayers' election. Judicial notice shall be taken of incorporated sewer districts. The county courts shall appoint a board of trustees to discharge the business of each district.

Each municipality within a district shall appoint an advisory board to make recommendations to the board of trustees. Each district shall have the power of eminent domain. The costs of sewer districts may be met by expenditure of funds received legally from the state, the United States or any municipality, or from the proceeds of revenue bonds issued by the district. Bonds shall be payable solely from revenues derived from operation of the sewer system. Each district shall fix rates for sewage disposal sufficient to pay principal and interest on bonds issued by the district. Such rates shall be maintained until the bonds of the district are retired. (Dye-Florida) W70-06024

J HUNGERFORD SMITH CO V INGRAHAM (ORDER OF HEALTH COMMISSIONER TO CEASE AND DESIST DISCHARGE OF INADEQUATELY TREATED WASTE).

301 NYS2d 266-271 (SC NY 1969).

Descriptors: *New York, *Public health, *Administrative agencies, *Administrative decisions, Legislation, Environmental sanitation, Sewage, Judicial decisions, Legal aspects, Waste treatment, Waste disposal, State governments, Regulation, Administration, Adjudication procedure, Water pollution control, Industrial wastes.

The respondent corporation was charged with discharging inadequately treated sewage and industrial wastes into New York waters. On January 26, 1967, the Commissioner of Health issued an order directing respondent to cease and desist all discharges of industrial wastes on February 1, 1967 unless actions were initiated to effect a more adequate treatment of wastes from respondent's plant on or before October 1, 1967. On January 19, 1968 respondent commenced a proceeding to review and annul the Commissioner's order. The Commissioner filed a motion to dismiss the petition as untimely under the statute of limitations. The trial court found that the Commissioner's order did not become final and binding, and thus subject to judicial review, until October 1, 1967. Therefore, since the proceeding was commenced within four months of October 1, 1967, the statute of limitations had not run. The appellate court reversed and held that the basic four-month statute of limitation was not applicable. The court reasoned that the Public Health Law required review of the Commissioner's determination to be made within sixty days after service of the determination or decision. The court also held that the Commissioner's order became final and binding upon respondent on February 1, 1967 and not on October 1, 1967 with respect to timeliness. (Powell-Florida) W70-06026

CONTROL OF POLLUTION BY UNDERWATER STORAGE, FEASIBILITY OF PROVIDING TEMPORARY UNDERWATER STORAGE OF STORM OVERFLOW FROM A COMBINED SEWER SYSTEM.

Underwater Storage, Inc., Washington, D.C. For primary bibliographic entry see Field 05D. W70-06029

AIDS TO MUNICIPALITIES FOR PREVENTION AND ABATEMENT OF WATER POLLUTION.

Wis Stat Ann sec 66.33 (1965), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Cities, *Water pollution, *Pollution abatement, Water pollution control, Water pollution treatment, Grants, Federal government, Administrative agencies, Construction, Utilities, Industries, Contracts, Sewage disposal, Sewage, Industrial wastes, Sewage treatment, Waste treatment, Coordination, Projects, Treatment facilities, Water resources. Identifiers: Public improvements.

Any municipality may apply for and accept grants or other aid which the federal government has authorized for the construction of public improvements for water pollution abatement. Municipalities may also accept aid from commercial, industrial and other establishments to aid in water pollution abatement. Cities may contract to: collect, treat, and dispose of sewage and industrial wastes; use and operate sewage facilities owned by such establishments; coordinate municipal and industrial sewage facilities; and to construct sewage and other facilities to handle the discharges of industrial wastes. Any municipality may participate in the state financial assistance program for water resources protection and make agreements with the Department of Resource Development for that purpose. Municipalities may also make contracts for the design and construction of projects to be subleased from the Department of Resource Development. (Duss-Florida) W70-06055

INDUSTRIAL CONTROL FACILITIES: CERTIFICATE (WATER POLLUTION ABATEMENT OR CONTROL FACILITIES).

Ohio Rev Code Ann secs 6111.31 thru 6111.40 (Page, Supp 1970).

Descriptors: *Ohio, *Water pollution control, *Treatment facilities, *Industrial wastes, Legislation, Water pollution treatment, Pollution abatement, Sewage treatment, Waste water treatment, Waste treatment, Industrial plants, Industrial water, Taxes, Regulation, Wastes, Municipalities, Legal aspects, Federal government, State governments, Water pollution, Administrative agencies, Administration.

Identifiers: *Tax exempt facilities.

Industrial water pollution control facilities that have been approved by an authorized agency are exempt from property, franchise and sales taxes. Application for approval shall be made with the Water Pollution Control Board, which notifies the taxing authority if the application is allowed. The tax commissioner or county auditor may request a hearing for reconsideration. If the application is allowed, the Board shall issue an industrial water pollution control exemption certificate. After a hearing, the certificate may be revoked or modified if the facilities are not completed or cease to be used. Appeals concerning the issuance of certificates are made to the county court. So long as the certificate is in force, the facility continues its tax-exempt status. The certificate may be transferred when the facility is transferred. Municipal corporations, county commissioners or districts may apply to the Water Pollution Control Board for state financing of sewage treatment works. The amount should be that necessary to obtain the maximum federal grants. The Board may adopt rules and regulations governing the handling of this money. (Doubrey-Florida) W70-06064

THE INDUSTRIAL WASTES CONTROL PROGRAM IN NEW YORK CITY.

Department of Water Resources, New York. Bureau of Water Pollution Control. Charles Imbelli, William V. Pressman, and Harold Radiloff. Journal Water Pollution Control Federation, Vol 40, No 12, p 1981-2012, Dec 1968. 11 fig, 9 tab, 7 ref.

Descriptors: *Industrial wastes, *Legislation, Costs, Pilot plants, Sampling, *Sewage treatment, *Water pollution control, Waste water treatment. Identifiers: *New York City.

New York City's inaction of a local law for the control of industrial waste discharges to the sewer system is unique because of the variety of manufacturers and service type industries involved. In the middle thirties action was begun to unify piecemeal laws previously enacted and resulted in the Charter

of 1938. In 1962 authority and responsibility for the operation of the entire sewer system was assigned to the Department of Public Works. Discussion of the law, the surcharge formula used, and the problems of program organization are covered extensively. The surcharge formula incorporates cost per pound of removing pollutants, volume of wastewater discharge, concentration of suspended solids, and biochemical oxygen demand. These surcharges are based on concentrations of suspended solids and BOD over and above 'normal sewage'. Results of pilot studies using new techniques and description of several unique waste problems, sampling methods, and equipment used are included. Several industries requiring pre-treatment were described in detail with regard to their particular problem. These wastes were industrial laundries, metal platers, acid wastes, paints and varnishes, commissaries, and soap manufacturers. Revenue realized by surcharging is substantial. (Hancuff-Texas) W70-06072

STREAM POLLUTION (STREAM POLLUTION CONTROL BOARD).

Tenn Code Ann secs 70-301 thru 70-323 (1956), as amended, (Supp 1970).

Descriptors: *Tennessee, *Water pollution control, *Water pollution, *Pollution abatement, Stream improvement, Legislation, Navigable waters, Streams, Sewage, Sewage disposal, Cities, Wastes, Sewage treatment, Industrial wastes, Municipal wastes, Water pollution treatment, Water quality, Public health, Pollution, Water resources development, Interstate rivers, Administration, Administrative agencies, Permits, Legal aspects.

The Tennessee Stream Pollution Control Board is created and provisions regarding membership, compensation and meetings are set forth. The Department of Public Health is the administrative agent for the Board. The Board's duties are to: (1) supervise the administration and enforcement of all laws relating to pollution; (2) establish standards of water quality and general policies of permissible pollution; (3) issue permits for the discharge of sewage and wastes; (4) issue special orders directing persons responsible for pollution, except governmental bodies without funds, to conduct research and submit plans for pollution control; (5) conduct surveys respecting the pollution of streams; (6) determine location of lakes for purposes of soil and water conservation, recreation, and the propagation of fish; and (7) take all appropriate steps to prevent pollution contrary to the public interest, or to established standards and policies. The Governor may negotiate with other states to prevent and control pollution of streams having their source in other states. Sewage, industrial wastes and pollution are defined. (Casey-Florida) W70-06076

TOM SAWYER MOTOR INNS, INC. V CHEMUNG COUNTY SEWER DISTRICT NO 1 (NUISANCE CAUSED BY SEWAGE TREATMENT PLANT).

305 TSUSPENDED SOLIDS AND BOD over and above 'normal sewage'. Results of pilot studies using new techniques and description of several unique waste problems, sampling methods, and equipment used are included. Several industries requiring pre-treatment were described in detail with regard to their particular problem. These wastes were industrial laundries, metal platers, acid wastes, paints and varnishes, commissaries, and soap manufacturers. Revenue realized by surcharging is substantial. (Hancuff-Texas) W70-06072

STREAM POLLUTION (STREAM POLLUTION CONTROL BOARD).

Tenn Code Ann secs 70-301 thru 70-323 (1956), as amended, (Supp 1970).

Descriptors: *Tennessee, *Water pollution control, *Water pollution, *Pollution abatement, Stream improvement, Legislation, Navigable waters, Streams, Sewage, Sewage disposal, Cities, Wastes, Sewage treatment, Industrial wastes, Municipal wastes, Water pollution treatment, Water quality, Public health, Pollution, Water resources development, Interstate rivers, Administration, Administrative agencies, Permits, Legal aspects.

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TOM SAWYER MOTOR INNS, INC. V CHEMUNG COUNTY SEWER DISTRICT NO 1 (NUISANCE CAUSED BY SEWAGE TREATMENT PLANT).

305 N Y S 2d 408-413 (1969).

Descriptors: *New York, *Sewage districts, *Treatment facilities, *Damages, Administrative agencies, Water pollution control, Water pollution treatment, Local governments, Sewage treatment, Legislation, Damages, Remedies, Administration, Judicial decisions, Legal aspects.

Plaintiff sued to enjoin an alleged nuisance arising out of the operation of defendant's sewage treatment plant. The court held that the legislation pursuant to which defendant sewer district was established authorized the creation of sewer boards only as administrative arms of the county, and not as separate and independent government units. Therefore, the sewer district could not be sued, and the county itself was the party who was liable. However, the proof as regarded the quantum of damages was insufficient and the case was remanded for a new trial on the issue of damages. (Caldwell-Florida) W70-06091

THIRD CLASS CITIES (SEWAGE SYSTEMS).

Mo Ann Stat secs 88.540 thru 88.560 (1952).

Descriptors: *Missouri, *Cities, *Drains, *Drainage systems, Sewers, Public health, City planning, Municipal wastes, Treatment facilities, Urbanization, Sanitary engineering, Drainage programs, Drainage engineering, Water management (Applied), Engineering structures, Sewage disposal, Environmental sanitation, Legislation, Legal aspects, Utilities, Drainage, Sewage districts.

The acting municipal authorities of a third class city may, by ordinance, provide drains, sewers and all necessary plants for the disposal of sewage. Third class cities may accept and acquire, by gift, devise, purchase or condemnation, the rights-of-way for drains or sewers, the necessary land for the erection and maintenance of all necessary disposal plants, and the use of natural watercourses of drainage for public drainage and sewer purposes of such city. Before authorizing or constructing sewers or drains, the third class city subdivides its territory into two or more sewer districts. A general

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

sewer system consists of four classes of sewers: public, district, joint district, and private. Public sewers are established along the principal courses of drainage. District sewers connect with the public sewers, other district sewers, or the natural course of drainage and may be constructed with the main branch or discharge pipe wholly within or beyond the district boundary. Joint sewers are constructed when it is necessary that a sewer be constructed in any part of the city containing two or more sewer districts. The third class city incurs no expense in the construction, repairing or cleaning of private sewers. No public sewer is to be constructed through private property when it is practicable to construct it along or through a street or other public highway. (Powell-Florida)
W70-06092

PHYSICAL AND ECONOMIC FACTORS ASSOCIATED WITH THE ESTABLISHMENT OF STREAM WATER QUALITY STANDARDS, VOLUME I,
Iowa State Univ., Ames. Engineering Research Inst.
For primary bibliographic entry see Field 05B.
W70-06094

THE DELAWARE VALLEY ENVIRONMENT: STATUS AND PROSPECTS.
Greater Philadelphia Chamber of Commerce, Pa.; and University City Science Center and Inst., Philadelphia, Pa.
For primary bibliographic entry see Field 06G.
W70-06101

UNITED STATES V INTERLAKES STEEL CORP (GOVERNMENT ACTION TO ABATE POLLUTION).

297 F Supp 912-917 (N D Ill 1969).

Descriptors: *Illinois, *Rivers and Harbors Act, *Federal government, *Water pollution control, Judicial decisions, Legislation, Rivers, Legal aspects, Water pollution treatment, Pollution abatement, Pollutants, Industrial wastes, Oily waters, Oil wastes, Public health, State governments, Treatment facilities, Water Quality Act.

The United States attorney charged defendant steel corporation with discharging iron particles and an oily substance into The Little Calumet River in violation of secs 13 of The Rivers and Harbors Act of 1899. Defendants made a motion to dismiss the information on the grounds that it was fatally defective: (1) because it failed to allege that the prosecution was undertaken at the request of an officer authorized to do so under secs 17 of the Act; (2) that it failed to allege that the defendant willfully violated the Act; and that (3) there had been no crime committed against the United States. As to (1) above the appellate court held that where the information is not given by an authorized officer under the Act, the right and duty of the federal prosecuting officer to initiate proceedings in the manner usual to criminal cases is not affected. As to (2) above, the court held that the Act does not require any element of scienter to be shown for conviction of a substantive offense in this case. The third allegation failed also in that the Water Quality Act of 1965 does not supersede the provisions of the Rivers and Harbors Act under which the prosecution was brought. Motion to dismiss the information was denied. (Barnett-Florida)
W70-06107

MICROBIOLOGICAL FACTOR IN ACID MINE DRAINAGE FORMATION: A PILOT PLANT STUDY,
Carnegie-Mellon Univ., Pittsburgh, Pa.
Robert A. Baker, and Albert G. Wilshire.
Environmental Science and Technology, Vol 4, No 5, p 401-407, May 1970. 7 p, 1 fig, 5 tab, 14 ref.

Descriptors: *Acid mine water, *Iron bacteria, *Sulfur bacteria, *Water chemistry, *Water pollution sources, Water quality, Ferrobacillus, Thiobacillus ferrooxidans, Aquatic bacteria, Oxidation, Pyrite, Iron compounds, Hydrolysis, Microbiology, Aerobic bacteria, Anaerobic bacteria, Aerobic conditions, Anaerobic conditions. Identifiers: *Acid mine water microbiology.

The role of chemoautotrophic organisms (Ferrobacillus ferrooxidans, Ferrobacillus sulfooxidans, Thiobacillus thiooxidans) in the formation of acid mine drainage from pyritic materials associated with coal mining has been studied by use of pilot plant reactors. Equilibria were achieved under conditions of aeration or nonaeration and biological seeding or nonseeding at specified hydraulic flow rates. These organisms accelerate oxidation of ferrous iron and sulfide but do not alter the pyritic dissolution rate. In the absence of organisms, effluent ferrous content is greater under aerobic than anaerobic conditions. Ferric content is negligible. Oxygen exclusion does not prevent pyritic dissolution. Under dynamic conditions a steady-state ferrous and sulfide release occurs. Mine sealing practices to eliminate air entry may reduce but will not prevent acid release. Despite an acidic environment, if organic carbon is present, heterotrophic organisms may develop in the aerated systems, and may affect autotrophic metabolism. (Knapp-USGS)
W70-06128

GUIDELINES FOR INVESTIGATIONS INTO THE QUALITY ASPECTS OF WATER RESOURCES RESEARCH,
California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 06B.
W70-06179

ORGANIC MATTER AND FINISHED WATER QUALITY,
East Bay Municipal Utility District, Oakland, Calif. J. J. Connors, and R. B. Baker.
Journal American Water Works Association, Vol 61, No 3, p 107-113, Mar 1969. 7p, 10 ref, 2 tab, 6 graphs.

Descriptors: *Organic matter, *Pollutant identification, *Water quality control, Surface waters, Analytical techniques, Indicators, Pollutants, Water pollution, Water pollution sources, Wastes, Water pollution control, Organic loading, Biochemical oxygen demand, Organic compounds, Organic wastes, Sewage, Water properties, Potable water, Distribution systems, Reservoirs, Reservoir operation, Reservoir storage, Water quality, Organoleptic properties. Identifiers: Impaired water quality.

Water quality deterioration can occur because of an accumulation of organic matter after water treatment. This study attempts to establish a basis for the management of a surface supply so as to minimize the overall organic content of the supply. Tests for organic matter levels include: (1) biochemical oxygen demand; (2) chemical oxygen demand; and (3) total organic carbon. There are several points of control of organic matter: (1) the watershed; (2) impoundment; (3) the treatment plant; and (4) the distribution system. Discussions of the results obtained in several treatment systems are analyzed, including the East Bay Municipal Utility District in Oakland, California. It is concluded that: (1) significant differences in amounts of organic matter can occur in similar reservoirs; (2) treatment of organic matter by copper sulfate may be fruitless in some reservoirs; (3) the algal biomass is a minor contributor to the total organic matter present; (4) the total organic load is sometimes established by the character of runoff; (5) organic removals by filtration are slight compared with those by coagulation and sedimentation; and (6) the chemical oxygen demand test can be made to yield good precision with potable waters. (Dye-Florida)
W70-06192

RAW WATER QUALITY CRITERIA FOR PUBLIC SUPPLIES.

For primary bibliographic entry see Field 05F.
W70-06193

PUBLIC RELATIONS, LAW, ENVIRONMENTAL POLLUTION,

Cleveland State Univ., Ohio.
Barbara L. Schoonover, and David J. Sherriff.
Cleveland State Law Review, Vol 18, No 3, p 467-472, Sept 1969. 6 p, 16 ref.

Descriptors: *Social change, *Attitudes, *Pollution abatement, *Environment, Decision making, Social aspects, Social needs, Social participation, Psychological aspects, Behavior, Motivation, Air pollution, Water pollution, Political aspects, Political constraints, Governments, Legal aspects, Legislation, Clean air act, Jurisdiction. Identifiers: *Public relations.

The relationship between public relations and the law in efforts to control environmental pollution is discussed. Public relations can complement the law by creating an atmosphere in which the law can better perform its function of protecting the people. Various air and water pollution laws are cited and reasons given why they are inadequately enforced. The most important reason is the lack of general public interest. Public relations about law and pollution can make the people aware of the extent and urgency of the problem. The Cleveland experience with public relations and advertising to fight pollution is mentioned. Public relations activity to change laws should be undertaken on a national scale. In addition, local campaigns should be conducted in the major pollution regions to show that pollution statutes need change and stricter enforcement. (Cuevas-Florida)
W70-06200

MAINE LEGISLATIVE RESEARCH COMMISSION: SUBCOMMITTEE REPORT AND PROPOSED LEGISLATION (OIL DISCHARGE PREVENTION AND POLLUTION CONTROL).

Maine Legislative Research Comm, Pub no 104-24, 104th Legislature, 1st Special Sess 1-27 (Jan 1970).

Descriptors: *Maine, *Oil industry, *State governments, *Legislation, Storage tanks, Oil wastes, Distillation, Water pollution sources, Oily water, Pipelines, Shore protection, Harbors, Transportation, Water pollution control, Pollution abatement, Storage tanks, Estuaries, Coasts, Beaches, Public lands, Legal aspects, Administrative agencies, Oil costs, Cost repayment, Regulation. Identifiers: *Oil pollution, *Oil spills.

Within three years Maine will face a 300 percent increase in oil tonnage moving through her waters. Citing statistics on past oil spills and the problems of transporting oil by ship, the legislative Subcommittee charged with studying coastal conveyance of petroleum products through Maine herein proposes legislation to regulate oil transportation activities. The proposed act establishes an Environmental Improvement Commission empowered to adopt and enforce regulations for the prevention of discharge or spillage of oil in Maine waters. The Commission may set out operating instructions for oil terminal facilities, establish procedures for reporting discharges, prescribe oil removal methods, and establish control districts. The Governor of Maine may declare a state of emergency and is authorized to cooperate with federal authorities when serious oil spills occur. The Maine Coastal Protection Fund is proposed to finance regulatory and clean-up activities. Violators of the Commission's regulations must pay fines to the Fund and also must pay third-party damages. Violators must also pay oil removal costs when the state undertakes the removal of spilled oil. (Hubener-Florida)
W70-06204

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN.

U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2 (1969).

Descriptors: *Lake Michigan, *Water pollution control, *State governments, *Federal government, Governments, Water pollution, Thermal pollution, Pollution abatement, Standards, Water conservation, Water pollution treatment, Water pollution sources, Oil wastes, Domestic wastes, Pesticide residues, Industrial wastes, Sediments, Radioactive wastes, Ships, Nuclear powerplants, Monitoring, Fishkill, Area redevelopment, Planning, Regulation.

Reports are given by states and government agencies as to steps taken to abate pollution in Lake Michigan pursuant to recommendations established in prior conferences. The Wisconsin report lists the extent of compliance with each of the recommendations directed at the states. The Department of Agriculture report outlines what is being done to reduce sediment pollution. A report is made on discharges from federal installations, and proposed legislation for uniform regulations to control watercraft wastes is submitted. The extent of thermal and radiation pollution from nuclear powerplants is outlined with existing regulations that are designed to control it. A report is made on the extent of pollution from insecticides with recommendations for control. A monitoring program is outlined that obtains data useful in identifying pollutants in Lake Michigan and its tributaries. Reports are made on plans to control pollution from oil spills and from alewife die-offs in the Lake. A summary of the proceedings is made by the conferees. (See also W70-06206 thru W70-06209). (Doublerley-Florida) W70-06205

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (WISCONSIN PROGRESS REPORTS).

U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2, p 365-462, 97 p, (1969).

Descriptors: *Wisconsin, *Water resource development, *Water pollution control, *Standards, Lake Michigan, Water resources, Surface waters, Water conservation, Water management (Applied), Water policy, Water quality, Water pollution, Water treatment, Administration, Area redevelopment, Planning, State governments, Sewage, Effluents, Disinfection, Treatment, Zoning, Land use, Landfills, Phosphorus, Pollution abatement, Administrative agencies.

The Wisconsin Department of Natural Resources was created to combine both pollution and resource management functions in one administrative body. Water quality standards have been extended to cover both interstate and intrastate waters, requiring secondary treatment of sewage and wastes as well as disinfection of effluents. Counties are required to zone all shore lands in unincorporated areas to protect against unwise development. Dumps and sanitary landfills are regulated by state licensing procedures. It is suggested that the Conference recommendation that municipalities achieve an eighty percent reduction in phosphorus be considered in light of the total phosphorus load in each state rather than applied to each individual municipality. Larger cities can attain greater than eighty percent, while smaller municipalities cannot feasibly treat phosphorus effluents. Statutes prohibit the dumping of polluted materials into any waters of the state. (See W70-06205). (Doublerley-Florida) W70-06206

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (USDA PROGRAMS TO PREVENT AGRICULTURAL POLLUTION).

U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2, p 463-503, 40 p (1969).

Descriptors: *Erosion control, *Administrative agencies, *Federal government, *Soil conservation, Lake Michigan, Water pollution control, Administration, Water pollution, Planning, Pollution abatement, Farm management, Agricultural engineering, Contour farming, Drainage practices, Land use, Land management, Soil management, Land, Farms, Rural areas, Small watersheds, Sedimentation, Silting, Bank erosion, Erosion, Sediment control, Water conservation.

Agricultural lands supply the greatest amount of sediment carried by streams because of the large area involved, but much of sediment also comes from urban areas under construction, roadsides, surface mining, sand and gravel pits, and streambank erosion. The Department of Agriculture aids individuals, communities and government agencies in preserving soil and water resources through conservation. The Soil Conservation Service (SCS), through Soil Conservation Districts, assists conservationists and land users in planning and making decisions about proper land use. The Agricultural Stabilization and Conservation Service provides cost-sharing and technical assistance in establishing conservation practices. The Cropland Adjustment Program diverts land to uses that control air and water pollution. The Farmers Home Administration administers loans and grants for water supply and waste disposal systems, recreation facilities and conservation measures. Under the Small Watershed Program, SCS gives technical and financial aid to local watershed projects. SCS also provides leadership for resource conservation and development projects, including technical assistance and credit to finance local improvements. Research programs provide valuable data on soils, plants and water quality. (See W70-06205). (Doublerley-Florida) W70-06207

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (NUCLEAR POWERPLANT WASTE DISPOSAL).

U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan and Wisconsin, vol 2, p 537-691, 154 p, (1969).

Descriptors: *Lake Michigan, *Nuclear powerplants, *Nuclear wastes, *Thermal pollution, Water pollution, Water pollution control, Water quality, Planning, Facilities, Radiation, Disposal, Nuclear engineering, Nuclear reactors, Radioactive waste disposal, Water pollution sources, Heated water, Radioactivity effects, Temperature, Pollution abatement, Regulation, Municipal water, Recreation, Aquatic life, Mixing, Dispersion, Standards.

Nuclear power plant wastes are governed by criteria, standards and regulations set by the states, the Secretary of the Interior and the Atomic Energy Commission (AEC). The states bordering Lake Michigan each provide for maximum temperature limits and reasonable distances for mixing. Radionuclide limits are based on the Public Health Service 1962 Drinking Water Standards. AEC responsibility is limited to radioactive waste disposal and does not extend to thermal pollution. Concentration limits are directed at protecting individuals from exposure to radiation. Recommendations by the Federal Water Pollution Control Administration to the Secretary of the Interior set temperature limits for both recreational and fish life uses. Limits are placed on radionuclides in municipal water sources and in habitats for aquatic

life. Applications for AEC nuclear power plant licenses state that radioactive disposal will be in compliance with set standards. Danger from routine plant operations is remote, although there is a need for a plan to coordinate the agencies involved in the event of an accident. Lack of available information makes it difficult to evaluate the adequacy of proposals and regulations concerning the disposal of heated cooling water. Additional data is needed to deal with the problems created by additional power plants in the future. (See W70-06205). (Doublerley-Florida) W70-06208

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (NATIONAL MULTIAGENCY OIL CONTINGENCY PLAN).

U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2, pp 853-938, 85 p, (1969).

Descriptors: *Water pollution, *Pollution abatement, *Oil, *Project planning, Pollutant identification, Water pollution sources, Water pollution control, Warning systems, Oil wastes, Oily water, Abatement, Federal government, Governments, Planning, Future planning (Projected), Disposal, Legislation, Damages, Accidents, Inter-agency cooperation.

Identifiers: *Oil spills.

In response to a number of disastrous oil spills, the President directed the Secretary of the Interior to prepare multi-agency contingency plans for responding to oil spill emergencies. The plan establishes a national reaction team and provides guidelines for regional plans and reaction teams. Through the National Interagency Committee, the plan coordinates federal, state and local efforts and encourages the development of local capabilities to handle pollution incidents. The plan covers all navigable waters in the United States and areas immediately adjacent that would directly effect navigable waters. The person responsible for the pollution is encouraged to remove the pollution and to mitigate its effects. Direction of efforts on the scene of a pollution incident is under the control of a commander designated by either the Coast Guard or the Department of the Interior. As soon as a spill is discovered, the agencies concerned initiate containment actions. The area is cleaned up, the environment is restored to its pre-spill condition, and the pollutants are disposed of. Actions are taken to recover damages for injury to federal property and to enforce applicable laws. The applicable federal laws are listed briefly. (See W70-06205) (Doublerley-Florida) W70-06209

MECHANICAL REMOVAL OF ORGANIC PRODUCTION FROM WATERWAYS, Wisconsin Univ, Madison; and Corps of Engineers, New Orleans, La.

D. F. Livermore, and W. E. Wunderlich. Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, p 494-519, 1969. 7 fig, 62 ref.

Descriptors: *Eutrophication, *Water pollution control, *Productivity, Texas, Wisconsin, New York, Florida, Louisiana, Lakes, Nutrients, Phosphorus compounds, Water hyacinth, Water quality control, Harvesting, Maryland, Nitrogen compounds.

Identifiers: *Mechanical control, *Hydrosphere, Naias, Vallisneria, Eel grass, Potamogeton, Trapa natans, Africa, Alternanthera, Eichhornia, Salvinia, Nile River, Rhodesia, Myriophyllum, Milfoil, US Army Corps of Engineers, Alligator weeds, Chesapeake Bay, Water chestnut, Potomac River, Sassafrass River (Md), Redhead-grass, Elodea, Anacharis, Chataqua Lake (NY), Coontail.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Among highly undesirable effects of excessive eutrophication is overproduction of plants, both planktonic and macrophytic. Problems range in magnitude from minor reductions in recreational and esthetic quality to almost complete loss of utility for many purposes. Control of plant growth is accomplished by physical, chemical, biological, and mechanical means. Chemical control with algicides and herbicides is widely employed because it is easy, effective, and inexpensive; chemicals are probably the only method of controlling planktonic algal blooms in current use. Chemical methods are disadvantageous because they are potentially toxic to fauna, and their residual effects on ecosystems are unpredictable and poorly understood. Mechanical harvesting seems most ecologically sound: foreign substances are not introduced into water, nutrients are removed from cycles, lacustrine filling is reduced, biotic disturbances are apparently minimal. Growth of macrophytes is controllable with manual methods: powered cutting and uprooting devices, and larger systems for cutting and collecting. Effective for control of various plants, mechanical devices are described from Louisiana, Chesapeake Bay and tributaries, Florida, New York (city and state), and Wisconsin. Descriptions include equipment, effectiveness, and economics. Recent research in mechanical control is outlined, and potential avenues for further study are suggested. (See W70-03975) (Eichhorn-Wisconsin) W70-06212

EDUCATING THE PUBLIC IN NATURAL RESOURCES,
Wisconsin Univ., Madison. Dept. of Journalism; and Wisconsin Univ., Madison. Dept. of Wildlife Ecology.
Clay Schoenfeld.
Journal of Soil and Water Conservation, Vol 23, No 6 (4 p reprint), 1968.

Descriptors: *Environment, *Education, Public benefits, Pollution abatement, Conservation, Recreation, Social aspects, Environmental sanitation, Resources.

Identifiers: Public relations, Public responsibility, Public approval, Environmental quality, Resource management.

Inasmuch as the most effective use of natural resources is determined by public decisions, attitudes and involvement are the basis of defining and maintaining environmental quality. Good public education, via mass media, are necessary to interpret resource problems in order to resolve conflicting interpretations of what constitutes wise conservation. As the technical and organizational skills of the land conservationist are inferior to the land exploiter, a stream of skills and resources at local and regional levels is required to translate federal intentions and state plans into positive action. We must develop a culture which recognizes man's interdependence with his environment and his responsibility for maintaining it. The public must be taught to weigh alternatives and make rational choices concerning natural resources in order that the experts' ideology are brought to the level of the citizenry in the form of 'environmental' education, which is more comprehensive in describing our efforts to cope with the degradation of our sphere than 'conservation' education—often limited in scope and associated with pressure groups. (Powers-Wisconsin) W70-06228

AIR POLLUTION AND ATOMIC POWER,
C. K. Viland.
Mines Magazine, Vol 60, No 1, p 17-23, Jan 1970. 5 p.

Descriptors: *Air pollution, *Atmospheric pollution, Electric power, *Electric powerplants, Nuclear energy, *Nuclear powerplants, Pollution abatement, Pollutants, Combustion, Radioisotopes, Nuclear explosions, Radiation hazards, Nuclear reactors, Health.

Identifiers: Air pollution control, Nuclear fuels, Nuclear safety, Fossil fuels, Health protection.

The need for electrical power is increasing faster than the population explosion. Many people fear the construction of a nuclear powerplant in their neighborhood because of association with the atomic bomb. Besides the inherent safety, a greater proportion of nuclear electrical powerplants, with respect to conventional steam plants, will alleviate air pollution. Nuclear plants are essentially free of emissions whereas impurities in the atmosphere from industry and transportation have increased in recent years. Scientists are becoming alarmed about the environmental changes taking place and the rapid rate of change. The article contains condensed material from numerous sources, and may serve a useful purpose in pollution control activities. (USBR) W70-06259

POLLUTION, LAW, SCIENCE, AND DAMAGE AWARDS,

Thomas M. Schmitz.
Cleveland State Law Review, Vol 18, No 3, p 456-466, Sept 1969. 11 p, 91 ref.

Descriptors: *Remedies, *Damages, *Water pollution control, *Cities, Environmental sanitation, Legal aspects, Pollution abatement, Public health, Standards, Water conservation, Water resources development, Water law, Governments, Remedies, Administration, Legislation, Judicial decisions, Water pollution, Environmental effects, Environment engineering, Water pollution treatment, Non-structural alternatives.

Identifiers: Nuisance (Public), Nuisance (Private), Injunction.

A historical survey of American courts' approaches to man-created environmental pollution problems is presented. Liability for air and water pollution has been based upon a variety of forms of actions, including negligence, nuisance, and trespass. A nuisance concept has developed in which a distinction has emerged between public and private nuisance. Compensatory and punitive damages are recoverable in law for injuries caused by environmental pollution. Equity will intervene and abate environmental pollution by injunction. Legal and equitable remedies are concurrent and, therefore, environmental pollution may be enjoined even though damages have been assessed. Environmental pollution interfering with the health and well-being of an entire community is a public nuisance which may subject wrongdoers to criminal prosecution. Municipalities are liable for environmental pollution created and maintained by them, even though such pollution may be pursuant to exercising a governmental function. Municipalities possess delegated police powers to abate pollution. Public officials charged with a duty to enforce pollution abatement laws are susceptible to liability for neglect of their official duties. Public pollution abatement laws have been upheld, and the expenditures for pollution controls are not considered unreasonable. Public pollution laws are invalid to the extent that compliance therewith is impossible due to a lack of scientific know-how. However, lack of suitable pollution controls is not a defense to a nuisance action initiated by a private citizen. (Powell-Florida) W70-06290

POLLUTION CONTROL AND THE FEDERAL POWER COMMISSION,

John A. Carver, Jr.
Natural Resources Lawyer, Vol 1, No 1, p 32-38, Jan 1968. 7 p, 16 ref.

Descriptors: *Administrative agencies, *Water pollution, *Pollution abatement, *Federal government, Air pollution, Federal Power Act, Thermal pollution, Environmental engineering, Public health, Hydroelectric plants, State governments, Hydroelectric project licensing, Permits, Regulation, Water resources development, Legal aspects.

Natural gas, Rates, Project planning, Water pollution control.
Identifiers: *Federal Power Commission.

Pollution of air and water is a universal problem. The effectiveness of federal, state, local and private efforts to do something about it is often criticized. The role of the Federal Power Commission is vital in affecting pollution due to its administration of The Federal Power Act and the Natural Gas Act. The Agency's response to the pollution question is an integrated answer due to the mixed character of its institutional ties, being legislatively, executively and judicially enmeshed. This mixture gives to the Agency a bi-partisan character allowing better central planning through its legislative function and giving a broad-spectrum consideration of pollution in its decision-making capacity. The Agency makes a severe impact on air and water pollution through its administrative functions in the licensing of new hydroelectric plants, arbitration of competitive fuel questions, and by interpreting the government's needs for regulated industry. In light of such governmental administrative functions, we must not overlook the individual. The fight against pollution is one that knows no political boundaries and is in need of cooperation from all sectors of government. (Barnett-Florida) W70-06292

RECENT DEVELOPMENTS IN INTERNATIONAL ENVIRONMENTAL POLLUTION CONTROL,

Frederick J. E. Jordan.
McGill Law Journal, Vol. 15, No 2, p 279-301, June 1969. 23 p, 111 ref.

Descriptors: *Governments, *Air pollution, *Water pollution, *Pollution abatement, Legal aspects, Political aspects, Federal government, Water resources development, International law, Environment, Environmental effects, State governments, Legislation, Social aspects, Environmental sanitation, United States.

Identifiers: Canada, Transboundary water pollution.

The extent and magnitude of water and air pollution in North America are discussed. The national aspects of environmental pollution problems in Canada and the United States are considered. Examples of Canadian-American boundary water pollution incidents are cited. The development of international rules relating to pollution control is generally outlined. The Helsinki Rules, adopted by the International Law Association, which relate to transboundary water pollution are examined. The laws and machinery for dealing with problems of environmental pollution in Canada and the United States are surveyed. It is pointed out that both governments have employed the International Joint Commission, created by the Boundary Waters Treaty, as an advisory agency in water pollution cases. Both states have accepted the Trial Smelter Arbitration case rule dealing with air pollution. In order to combat environmental pollution problems the Canadian and United States governments could amend the Boundary Waters Treaty to extend the water pollution obligations to transboundary air pollution. The International Joint Commission should be vested with jurisdiction over all matters of transboundary water and air pollution in regards to investigations and supervision of recommendations. (Powell-Florida) W70-06298

CONFERENCE COMMITTEE, NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, HR REP NO 91-765, 91ST CONG, 1ST SESS.

Clean Air and Water News, Vol 2, No 1, p 3-14, Jan 1970. 12 p.

Descriptors: *Legislation, *Environment, *Federal government, *Administrative agencies, Environmental effects, Federal project policy, Ecology, Urbanization, Pollution abatement, Population, En-

vironmental sanitation, Legal aspects, Social aspects, Institutional constraints, Industrial wastes, Political constraints, Political aspects, Government finance, Regulation, Quality control, Administration, Coordination, Public benefits, Public health.

Title I of the National Environmental Policy Act of 1969 declares it to be national policy that the environment be protected and maintained in the midst of urbanization and industrial development. All federal agencies are directed to study and identify methods by which environmental quality may be protected and to conform their regulations, policies, and procedures to the provisions of this Act. Every report or recommendation on federal legislation or other action must include a statement on the environmental impact of such action. Title II establishes the Council on Environmental Quality, which would serve as an advisory and investigatory agency concerned with coordinating the federal government's environmental policy. Differing versions of the Act were passed by the Senate and the House, though the differences were minor in nature. The joint conference committee agreed on provisions reconciling the different versions and recommended passage of the amended bill by both houses. (Caldwell-Florida)

W70-06299

THE MODIFICATION OF A PREDICTIVE RIVER BASIN MODEL,

South Dakota State Univ., Brookings.

Richard P. Covert.

Available from the Clearinghouse as PB-191 537, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, April, 1970. 13 p. OWRR Project A-014-SDAK (2).

Descriptors: *Computer model, *River forecasting, *Water level fluctuations, Basins, *Water quality, Low flow, Dissolved oxygen, Evaluation, Forecasting.

The computer model of the effect of the geographic and economic aspects of a river basin on the water quantity and quality of the given river that was originally developed at the University of Missouri was modified to accept distributed input and reaction factors and tested against low flow conditions on the Big Sioux River from the Sioux Falls wastewater treatment plant to the community of Klondike, thirty-two miles downstream. The model performed best for low flow conditions than for greater flows, but agreed with other investigators on the location of the point of minimum dissolved oxygen and in half of the trials with the amount of the minimum dissolved oxygen. The application of sensitivity analysis to the model indicated that the model was sensitive to initial flow, initial dissolved oxygen deficit, river temperature, Fair's factor, reach length, and amount of settleable organic waste.

W70-06313

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

DECISION CRITERIA FOR STOCHASTIC HYDROLOGY,

Water Resources Engineers, Inc., Springfield, Va.; and Water Resources Engineers, Inc., Walnut Creek, Calif.

George K. Young, Gerald T. Orlob, and Larry A. Roesner.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7209, p 911-926, April 1970. 16 p, 7 fig, 16 ref, append.

Descriptors: *Decision making, *Systems analysis, *Stochastic processes, *Mathematical models, Water resources development, Synthetic hydrology, Simulation analysis, Statistical models, Statistical methods, Data processing, Economics, Planning.

Identifiers: Stochastic hydrology.

A decision-theoretic plan is presented that provides insight into questions of interest to the system planner about to embark on a study which uses stochastic hydrology. The plan considers and integrates three broad areas: (1) The collection, interpretation, and adjustment of the data bank which is required to initiate stochastic modeling; (2) the investigation of existing, and development of new, stochastic hydrology models; and (3) the construction of water resource simulation procedures whose outputs serve as vehicles by which the importance of the other necessary tasks can be determined. The overall plan has component tasks which correspond directly to the design steps of the system planner, emphasizing data management. A scheme for multivariate data fill-in, based on variance reduction criteria, is presented. (Knapp-USGS)

W70-05910

OBJECTIVE DETERMINATION OF SAFETY FACTOR IN RESERVOIR DESIGN,

Geological Survey, Washington, D.C.; Geological Survey, Fort Collins, Colo.; and Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

For primary bibliographic entry see Field 08A.
W70-06111

DIGITAL MODEL OF ALLUVIAL AQUIFER,

Nova Scotia Dept. of Mines, Halifax; and Geological Survey, Washington, D.C.

Peter C. Trescott, George F. Pinder, and John F. Jones.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7264, p 1115-1128, May 1970. 14 p, 13 fig, 12 ref, append.

Descriptors: *Mathematical models, *Simulation analysis, *Aquifers, *Alluvium, Water supply, Municipal water, Water wells, Drawdown, Water yield, Induced infiltration, Water management (Applied), Digital computers.

Identifiers: Aquifer testing, Pumping tests, Antigonish (Nova Scotia).

The evaluation of an alluvial aquifer as a water supply for the Town of Antigonish, Nova Scotia, has demonstrated the versatility of the digital model as a tool in groundwater development and management. The digital model, which uses an alternating-direction implicit technique to solve the finite-difference approximation of the flow equation, is limited in size only by the available hydrogeologic data, the amount of computer storage, and availability of computer time. The model of the Antigonish aquifer, which is hydraulically connected to a river, was adjusted within the constraints dictated by the geology until the model response to a pumping stress approached the field response. The most critical factor was the river-bed hydraulic conductivity to thickness ratio which governs the drawdown required to induce enough water from the river to sustain well production. The adjusted model was used to predict the effect of establishing a multiple well field designed to meet the town's requirements. (Knapp-USGS)

W70-06130

WHY DO WE NEED CHEMICAL METHODS,

Marine Biological Association of the United Kingdom, Plymouth (England). Lab.

L. H. N. Cooper.

Chemical Environment in the Aquatic Habitat, Golterman, H L and Clymo, R S, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, p 15-23, 1967. 12 ref.

Descriptors: *Chemical analysis, *Planning, Sampling, Iron, Limnology, Oceanography, Meteorology, Geochemistry, Phosphorus compounds, Instrumentation, Research and development, Administration, Water chemistry, Marine fisheries, Nutrients, Phosphates, Silicates, Chromatography, Nitrogen compounds, Cyanophyta.

Estuaries, Amino acids, Bioassays, Vitamins, Physiological ecology, Plankton, Carbon cycle, Manganese, Economics.

Identifiers: Research ships, Iodine, Mass spectrometry, Physicochemical techniques, Greenhouse effect, Organic phosphorus, Chemical limnology, Chemical oceanography, Trichodesmium, India, Bay of Bengal, Vellar estuary (India), Exocrienes, Thiamin, Biotin, Growth factors, Fisheries research.

Increasingly, research must be justifiable on bases of practical and economic ends, including those of public health and welfare. Hydrochemical techniques are required for solution of practical problems in fisheries research, meteorology, and geochemistry. New methods and better understanding of old methods are needed, particularly regarding improvement of ship-borne instrumentation and facilities. Improved understanding of the ecological role of micronutrients and exocrienes will necessitate increased employment of sensitive bioassays. The problems of organic chemical oceanography are diverse and complex, and will likely require adaptation of costly instrumentation, including chromatography, mass spectrometry, and nuclear magnetic resonance spectroscopy. In meteorology, great importance attaches to the greenhouse effect, where physicochemical methods must be brought to bear in study of exchange of carbon dioxide at the hydrosphere-atmosphere interface. Similarly, physical understanding must be sought of kinetics and equilibria of iron, because of its nutrient status; iodine, in its role in public health; and manganese, because of economic considerations. Solutions to such problems raise seemingly insoluble administrative problems in connection with staffing, financing, and provision of adequate facilities to promote effective use of researchers' time. (See W70-04821) (Eichhorn-Wisconsin)

W70-06215

THE MODIFICATION OF A PREDICTIVE RIVER BASIN MODEL,

South Dakota State Univ., Brookings.

For primary bibliographic entry see Field 05G.
W70-06313

6B. Evaluation Process

KETHIKAN GATEWAY BOROUGH: WATER AND SEWAGE SURVEY,

Alaska State Housing Authority, Anchorage.

For primary bibliographic entry see Field 05C.
W70-06033

PREDICTING FUTURE GROWTH OF ORGANIC POLLUTION IN METROPOLITAN AREA RIVERS,

Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.

M. Marcus, and W. Whipple, Jr.

Available from the Clearinghouse as PB-191 218, \$3.00 in paper copy, \$0.65 in microfiche. Partial Completion Report. OWRR Project B-002-NJ, Feb. 1970. 29 p.

Descriptors: *Statistical methods, *Population, *Growth rates, *Water pollution, *Biochemical oxygen demand, *Mass water quality, Domestic wastes, Industrial wastes, Regression analysis. Identifiers: BOD Mass Balance Analysis.

This research report analyzes quantitative relationships between (a) growth of gross man-made pollution entering streams and (b) the growth of population and of various types of industrial activity. Three river basins in the rapidly growing New York-Philadelphia area were studied over an eleven-year period. Statistical correlation indicates that gross water pollution (prior to treatment) is growing with population, but more slowly, the growth rate being about 55% of the population growth rate. Consideration of various industrial in-

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

dices fails to improve the correlation. If relationships continue for 20 years for the Passaic River Basin as they were for the period 1957-67, the gross man-made pollution would increase by 85%. The relevance of such projections to water quality control planning appears obvious. (Whipple-Rutgers)

W70-06036

INCORPORATION OF AGRICULTURAL RISK INTO WATER RESOURCES PLANNING MODELS,

Texas A and M Univ., College Station. Inst. of Statistics; and Texas A and M Univ., College Station. Water Resources Inst.

For primary bibliographic entry see Field 03F.

W70-06100

GUIDELINES FOR INVESTIGATIONS INTO THE QUALITY ASPECTS OF WATER RESOURCES RESEARCH,

California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.

Jack Edward McKee.

Office of Water Resources Research Report, January 1966. 22 p, 1 fig.

Descriptors: *Water resources research act, *Research and development, *Water quality, Research facilities, Laboratories, Grants, Planning, Testing.

Identifiers: Water resources research, Office of Water Resources Research.

A brief background of investigations into the water-quality aspects of water-resources research is presented. The roles of various federal and other agencies in the area of water quality and the problems that appear to be in most urgent need of research by water-resources personnel are described. Measures for improving the character of, and potential for, future research are suggested. (Knapp-USGS)

W70-06179

FLOOD WARNING BENEFIT EVALUATION - SUSQUEHANNA RIVER BASIN (URBAN RESIDENCES),

Weather Bureau, Silver Spring, Md. Office of Hydrology.

For primary bibliographic entry see Field 06F.

W70-06182

PLANNING PROGRAM (1969).

Denver Board of Water Commissioners, Colo.

Board of Water Commissioners, Denver, Colorado, May 1969. 47 p, 9 fig, 12 tab.

Descriptors: *Planning, *Water resource development, *Water supply, *Future planning, *Long-term planning, *Financing, Construction, Capital costs, Construction costs.

Identifiers: *Denver Board of Water Commissioners, *Colorado River, Denver water supply program.

This water facilities planning report includes recommendations for construction and methods of financing the \$749,000,000 capital improvements program proposed for implementation during the forty-year period 1969-2008. The report parallels a 1969 capital improvement program report by Black and Veatch which covered the period 1969-1980. Proposed facility expansion and new facility construction is based upon an estimated three-fold increase in water requirements, from 216,000 acre feet in 1969 to 594,000 acre feet in 2008. The appropriation of new water supplies to meet this demand must come from the Colorado River system and from transmountain water sources. One 60 mgd addition at Moffat Treatment Plant, followed at 4 to 8 year intervals by five additional 100 mgd units are proposed to meet water treatment requirements. Major water transmission and

storage facilities are scheduled for construction to meet the added water demands and for integration of the Moffat and South Platte supplies for both load-shifting and system protection in case of major outage. Three alternative financing plans are deemed feasible. The plan recommended entails the use of \$107,000,000 from operating revenues, and financing of \$642,000,000 for the capital improvements. (Poertner-Chicago)

W70 06188

AMERICA'S DEPARTMENT OF NATURAL RESOURCES: THE UNITED STATES DEPARTMENT OF THE INTERIOR.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402-Price 40 cents. U S Dept Interior Report, 1969. 45 p.

Descriptors: *Federal project policy, *Federal government, *Water resources development, *Administrative agencies, Area redevelopment, Coordination, Programs, United States, Federal reclamation law, Federal reservations, Hydroelectric plants, Fish conservation, Fish management, Multiple-purpose projects, Geological surveys, Irrigation, Flood control, Water supply, Recreation, Water quality control, Desalination, Desalination plants, Desalination processes.

Identifiers: *Department of the Interior.

The Department of the Interior is the principal federal agency dealing with the nation's natural resources. Several bureaus within the Department carry out programs directly related to water conservation and use. The Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries conduct programs for the development of recreational and commercial fish resources. The Bureau of Outdoor Recreation conducts outdoor recreation planning for all federal water projects. The Geological Survey conducts studies of the quantity and quality of water throughout the country and compiles these studies into a national water data system. Several regional power agencies generate, transport, and market hydroelectric power from federally constructed water, flood and navigation projects. In 17 western states the Bureau of Reclamation coordinates federal projects whose purposes include: irrigation, flood control, navigation improvement, hydropower generation, municipal and industrial water supply, recreation, fish conservation, and water quality improvement. The Water Pollution Control Administration and the Office of Saline Water handle all activities dealing with water quality management and desalination of salt and brackish water. The Office of Water Resources Research sponsors research and training in the fields of water and resources which affect water. (Dearing-Florida)

W70-06197

CONSIDERATION OF ANTICIPATORY USES IN DECISIONS ON COASTAL DEVELOPMENT,

Rhode Island Univ., Providence. Dept. of Political Science.

For primary bibliographic entry see Field 06E.

W70-06201

WEATHER MODIFICATION AS AN UNCERTAIN INNOVATION,

Fred L. Strodtbeck.

Soc Sci Environ Conf Present Potential Contrib Soc Sci Res Policy Formulation Qual Phys Environ, p 103-124, Univ Colo, Boulder, Jan 31-Feb 2, 1967. 22 p, 1 tab, 11 ref, disc.

Descriptors: *Weather modification, *Social aspects, *Attitudes, *Social impact, Research and development, *Public opinion, Social values, Experimental data, South Dakota, Weather, Atmosphere, Legal aspects, Environment.

Identifiers: Hailswath Project (S Dak), Hermosa (S Dak), Research scientists, Interviews.

Acceleration of research on the physical science aspects of weather modification research suggests that attention should now be directed simultaneously to the social aspects. Public response to the problems of weather modification and the willingness of a community to permit weather modification experimentation must be studied. Local protest can become an insurmountable block to weather modification experimentation. Ranchers in Hermosa, S Dak, site of the Hailswath Project, were interviewed on the subject of weather modification; results of the survey are discussed. (USBR)

W70-06258

THE NERVOUS AFFAIR BETWEEN BEHAVIOR SCIENTISTS AND DESIGNERS,

City Univ. of New York.

Gary H. Winkel.

Psychology Today, Vol 3, No 10, p 31-35, 75, Mar 1970. 6 p

Descriptors: *Planning, Environment, *Environmental effects, Ecology, Social adjustment, Social aspects, *Social participation, Social values, *Human behavior, Project planning, Design, Urbanization, Urban renewal, Urban sociology, Housing, Recreation, Recreation facilities, Relocation, Architecture, Behavior (Psychology).

Identifiers: Social acceptance, Wilderness areas.

Solutions to environmental crises are not found easily in our complex society. The concept of participatory planning is presented as a step forward in solving the social and environmental problems confronting man, as in planning for urban renewal, housing projects, relocation of people in ghettos and disaster-prone areas, and recreational uses of wilderness areas. Some planners have argued that planning and design were not only a matter of aesthetics, but that the needs and preferences of the people who might suffer the consequences of design must also be considered. Interest has arisen from the feeling that environmental planning has been too authoritarian. Decisions have been imposed from above instead of growing out of the participation and consent of those affected by the decision. Participatory planning is based on the notion that those who live in a given place are in the best position to know their needs and requirements. The planner serves as a technician who listens to the community and explains the implications associated with the selection of various environmental alternatives, but ultimate choice rests with the community itself. (USBR)

W70-06263

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

RIDGEWOOD COUNTRY CLUB V BOROUGH OF PARAMUS (UNREASONABLE ASSESSMENT FOR SEWERS).

259 A2d 218-223 (NJ 1969).

Descriptors: *New Jersey, *Cost-benefit ratio, *Assessments, *Sewers, Judicial decisions, Cost allocation, Cities, Local governments, Cost-benefit analysis, Cost-benefit theory, Benefits, Project planning, Lateral, Real property, Land use, Land classification, Zoning, Sewage disposal, Taxes, Legal aspects.

Defendant municipality levied a special assessment of \$154,333 upon plaintiff for benefits from a sanitary sewer line placed along plaintiff's 260-acre golf course. Without using a discernible formula, acreage was assessed at \$1200 per acre, and other parcels were assessed on a modified front footage basis. Plaintiff contested the assessment on the grounds that it received no benefits from the improvement and that the assessment was excessive. The trial court reduced the assessment to \$15,000 and the appellate court affirmed. Upon this appeal, the supreme court found that plaintiff's land

received a benefit from the sewer even though the golf course had no immediate use for it. Its value was increased for residential purposes, which was a legitimate use of the land. However, the court found that the assessment was unreasonable and excessive. It bore no relationship to the front foot formula employed for other parcels and did not consider the future cost of laterals necessary to connect to the trunk line. The case was remanded for the municipality to arrive at an assessment that bore the same relationship to the net benefits to the property as that borne by other properties. (Doublerley-Florida)
W70-05964

MILESTONE V WASHINGTON SUBURBAN SANITARY COMM'N (SUBSEQUENT BENEFIT ASSESSMENTS ON THE SAME TRACT OF LAND).

260 A 2d 43-57 (Ct App Md 1969).

Descriptors: *Assessments, *Maryland, *Sewers, Real property, Judicial decisions, Benefits, Project benefits, Local governments, Cities, Financing, Boundaries (Property), Legal aspects, Administrative agencies.

Identifiers: Benefit charges, Frontage assessments.

Plaintiff landowner was assessed for sewer benefits according to the frontage of his property which actually abutted the sewer line. He paid the entire amount that the Sanitary Commission computed as redeeming the benefit charges in full. Subsequently, a portion of the tract was developed by the erection of apartment buildings which were connected to the existing sewer. The land was reclassified according to an amendment to the statute, and an additional benefit charge was imposed. Plaintiff complained on the grounds that the benefit charges for the entire tract had already been redeemed. The court held that the Commission was justified in treating the tract as more than one lot under the then applicable law. The assessment was proper. The only assessment made previously was in reference to the frontage abutting the sewer, and the remainder of the tract had made no contribution to the sewer installation. The dissent would have treated the benefit charges as redeemed, since it was the intention of both parties to remove the lien or encumbrance attached to the charges. Also, the changed law authorizing the reclassification should not have been applied retroactively. (Doublerley-Florida)
W70-06019

EXETER REALTY CORP V TOWN OF BEDFORD (ENTRANCE FEE FOR CONNECTION TO SEWAGE FACILITIES UPHELD).

252 NE2d 885-889 (Mass 1969).

Descriptors: *Local governments, *Massachusetts, *Sewers, *Sewage disposal, Cost allocation, Legislation, Construction costs, Costs, Cost sharing, Cost repayment, Government finance, Taxes, Sewage, Judicial decisions, Legal aspects, Water law, Financing, Assessments, Rates.

Plaintiff land developer subdivided and constructed dwellings on property within defendant town. Defendant sought to levy an entrance fee on plaintiff for the connection of sewage facilities, constructed within plaintiff's subdivision, to the town sewage system. Statutes authorized towns to provide for construction and maintenance of sewers by assessment of entry fees as determined by the town. Plaintiff contended that defendant exceeded its authority by levying the connection fee. The town had assessed at reduced rates for entry of previously constructed facilities. The court held that defendant's assessment was reasonable and within its authority under statute. The assessment was reasonably designed to defray the cost of construction and maintenance of facilities beneficial to plaintiff. (Dye-Florida)
W70-06023

THE COST OF SEWAGE TREATMENT.
Newcastle-upon-Tyne Univ. (England).
For primary bibliographic entry see Field 05D.
W70-06061

COMPUTER ANALYSIS OF ENGINEERING ECONOMIC STUDIES,
Clinton Bogert Associates, Fort Lee, N.J.
Ivan L. Bogert.
Journal Water Pollution Control Federation, Vol 50, No 12, p 2033-2035, Dec 1968. 2 ref.

Descriptors: *Computers, *Costs, Analysis, Design, Digital computers, Plants, Programs, Sewers.

Identifiers: *Bergen County (NJ).

Computers have been used for the financial aspects of projects reports for the Bergen County Sewer Authority, New Jersey. The reports, required by law, must include 40 year estimates of domestic and industrial flows, required plant and sewer enlargement dates, capital and annual financial costs of present system and all future enlargements, and annual plant and system operating costs and rates applicable to the various participants both with and without the project being studied. Computer programming permits reduced professional time, rapid production of reports, more thorough study of possible variations in direct printing of calculations from computer sheets. (Hancuff-Texas)
W70-06080

OPERATING EXPERIENCES AT SWINDON, 1962-67,
Swindon (England).
For primary bibliographic entry see Field 05D.
W70-06081

SURVEY OF WASTE WATER RATES AND CHARGES,
Sewer Dept., Lafayette, La. Utilities System.
For primary bibliographic entry see Field 05D.
W70-06086

6D. Water Demand

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, SUMMARY REPORT.
Denver Board of Water Commissioners, Colo.

Denver Regional Council of Governments, July 1969. 26 p, 7 fig, 6 tab. HUD Project No. Colo. P-62.

Descriptors: *Water resources development, *Water supply, *Water demand, *Water shortage, *Planning, *Future planning, Construction, Construction costs, Long-term planning, Financing, Capital costs, Design criteria, Water conveyance. Identifiers: *Denver Board of Water Commissioners, *Denver water supply program, *Denver Regional Council of Governments.

The water resources and requirements of the Denver Metropolitan Area to the year 2010 were investigated. The investigation encompassed a 'primary study area' (Denver and the urbanized portions of Adams, Arapahoe, Boulder and Jefferson Counties) and a 'regional' area (Upper South Platte Basin plus some areas on the Western Slope). This report summarizes Volume I (Text) and Volume II (Technical Appendices). The present water supply exceeds requirements by about 60 percent; however, the distribution facilities are unbalanced causing water shortages in some communities. By 2010, assuming present expansion plans are implemented, the gap between supply and demand will close. The yearly supply capacity contemplated then (794,000 acre feet) will be matched with an almost equal demand (749,000 acre feet). Water is presently obtained from the South Platte and tributaries, transmountain diversions, and groundwater (wells). Conver-

sion of water from other uses, primarily agricultural, and acquisition of additional water rights will continue to increase the domestic supply. The best potential for the largest additional supply involves the importation of transmountain water. Groundwater is not anticipated to be a major source of additional water. Three alternative organization plans for providing water supply and service are presented. Estimated capital improvement costs range between \$824,000,000 and \$899,000,000. (See also W70-06186 and W70-06187). (Poertner-Chicago)
W70-06185

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME I - TEXT.

Denver Board of Water Commissioners, Colo.

Denver Regional Council of Governments, July 1969. 110 p, 19 fig, 15 tab, 48 ref. HUD Project No. Colo. P-62.

Descriptors: *Water resources development, *Water supply, *Water demand, *Water shortage, *Planning, *Future planning, Construction, Construction costs, Long-term planning, Financing, Capital costs.

Identifiers: *Denver Board of Water Commissioners, *Denver water supply program, *Denver Regional Council of Governments.

The water resources and requirements of the Denver Metropolitan Area to the year 2010 were investigated and reported upon in two volumes. Volume I is the text for the report, and Volume II contains Technical Appendices. A Summary Report was also published. The geographical area included in the study comprised a primary area which included the City and County of Denver and four other urban counties in the Denver Metropolitan Area. A regional area which included the South Platte River Basin and areas on the Western Slope was also studied. It was found that the present water supply exceeds requirements by about 60 percent. However, assuming that only present plans are implemented, the water demand by the year 2010 will nearly equal the supply capacity planned. Recommendations are included for a capital improvements program which is estimated to cost between a minimum of \$824,000,000. The best potential viewed for increasing the available water supply involves the importation of transmountain water. (See W70-06185). (Poertner-Chicago)
W70-06186

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME II - TECHNICAL APPENDICES.

Denver Board of Water Commissioners, Colo.

Denver Regional Council of Governments, July 1969. HUD Project No. Colo. P-62.

Descriptors: *Water resources development, *Water supply, *Water demand, *Planning, *Design criteria, *Future planning, *Water treatment, *Water storage, *Water conveyance, Construction.

Identifiers: *Denver Board of Water Commissioners, *Denver water supply program, *Denver Regional Council of Governments.

Volume II is a compendium of detailed technical information concerning water treatment, pumping, storage and transmission for the 24 largest water supply agencies in the Denver metropolitan region. Criteria were established by the Water Advisory Committee of the Denver Regional Council of Governments to assess objectively each water agency. The per capita consumption experience was documented and summarized for each agency. Projections were made of water consumption on an average-day basis. Ratios of maximum-day to average-day water requirements were used for sizing raw water transmission and pumping. Maximum-hour to average-day ratios were used for siz-

Field 06—WATER RESOURCES PLANNING

Group 6D—Water Demand

ing transmission and distribution mains, and treated water storage facilities. An addendum to this volume lists for each agency the detailed population projections, water demand forecasts and supply requirements, by census tract, for 1968, 1975, 1990 and 2010. The present and projected service system of each agency is summarized. Scheduled expansion of each agency, where applicable, is described in terms of supply, treatment, storage, transmission and pumping station requirements. Estimated future capital and operating costs of each agency are tabulated. General conclusions regarding joint development of water systems is included. (See W70-06185). (Poertner-Chicago) W70-06187

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION,

For primary bibliographic entry see Field 06E.

W70-06300

6E. Water Law and Institutions

AVON PARK, INC V STATE (NECESSITY FOR EXPLANATION OF DAMAGES IN CONDEMNATION PROCEEDING).

305 NYS2d 560-563 (1963).

Descriptors: *New York, *Condemnation value, *Eminent domain, *Drainage, Judicial decisions, Condemnation, Cost repayment, Compensation, Value, Damages, Drainage practices, Road construction, Highways, Real property, Land classification, Land appraisal, Land use, Right-of-way, Legal aspects.

In an eminent domain proceeding to appropriate land for highway drainage purposes, the trial court awarded direct damages of \$50 per front foot and consequential damages of \$3680. Upon appeal, the court held that there was nothing on the record to disturb the award of direct damages. The trial court was also sustained in its finding that the appropriation did not destroy all suitable access and thus change the highest and best use from commercial to residential. An access driveway could still be constructed. The award of consequential damages was set aside by the appellate court because of the lack of a supportive explanation for the award. The court held that a determination based solely on the court's subjective judgment cannot be upheld. (Doublerley-Florida) W70-05917

BUNCH V ABEL (SEPARABILITY OF REPAIR YARDS FROM MARINA).

260 A2d 19-21 (Ct App Md 1969).

Descriptors: *Maryland, *Zoning, *Marinas, *Repairing, Judicial decisions, Water zoning, Cities, Land use, Local governments, City planning, Boats, Inland waterways, Docks, Bulkheads, Construction, Permits, Regulation, Building codes, Administrative agencies, Legal aspects.

Appellees applied for a zoning certificate and building permit for the construction of a bulkhead and seven slips to be added to their existing marina and boatyard. A municipal zoning ordinance did not permit boat repair yards within 500 feet of any residentially zoned district. The new bulkhead was to be within 500 feet of the adjoining residential property, but the application was approved by Planning Commission and affirmed by the Board of Zoning Appeals and the circuit court. Upon appeal, the court of appeals affirmed. Major repairs were done at the marina inside an enclosed building that was physically separated from the proposed bulkhead extension. The boat repair yard and marina were found to be divisible and separate enterprises, and the extension of the marina was not considered as an extension of the repair yard as well. Appellees gave assurances that only minor repairs would be done in the marina area, and on that basis the cir-

cuit court was held to be justified in granting the application. (Doublerley-Florida) W70-05921

SIBSON V STATE (JURISDICTION OF PORT AUTHORITY OVER SALT MARSH).

259 A2d 397-400 (N H 1969).

Descriptors: *New Hampshire, *Salt marshes, *Tidal marshes, *Tidal waters, Port authorities, Jurisdiction, Judicial decisions, Legislation, Real property, Marshes, Wetlands, Aquatic environment, Aquatic habitats, Land reclamation, Marsh management, Landfills, Land development, Shallow water, Tides, Legal aspects, Administrative agencies.

The New Hampshire Port Authority denied plaintiff permission to fill a parcel of marshland for residential purposes. The denial was made pursuant to a statute which required approval of the Authority before excavating or filling any bank, flat, marsh, or swamp in or adjacent to tidal waters. The court held that the property did not fall within the purview of the statute, and that the orders issued by the Authority were void for lack of jurisdiction. The court stated that tidal waters are public waters and may be regulated to prevent fill runoff back into tidal waters and to protect marine fisheries and wildlife. However, tidal waters are those in which the tide ordinarily ebbs and flows, and not those affected by the tide only in unusual circumstances. The land here was found not to be in or contiguous to tidal waters, and thus was not subject to regulation by the Authority. (Doublerley-Florida) W70-05972

PIC-N-PAY INC V STATE (JURISDICTION OF PORT AUTHORITY OVER TIDAL MARSH).

259 A2d 659-660 (N H 1969).

Descriptors: *New Hampshire, *Salt marshes, *Port authorities, *Jurisdiction, Judicial decisions, Real property, Marshes, Wetlands, Tidal marshes, Aquatic environment, Aquatic habitats, Land reclamation, Marsh management, Landfills, Land development, Legislation, Legal aspects, Administrative agencies.

Plaintiff owned a parcel of salt marsh that was susceptible to tides. His petition to fill the marsh for commercial purposes was denied by the New Hampshire Port Authority. The Authority stated that it was bound by the restrictive powers of the director of the Fish and Game Department, and the Department had found the salt marsh to be a necessary and vital part of the marine ecological complex. Upon appeal the court found that the land was not within the statutory jurisdiction of the Authority. Consequently, its orders relating to the land were null and void. (Doublerley-Florida) W70-05981

WESTERN CONTRACTING CORPORATION V TITTER (RIGHT OF ACCESS SUBJECT TO FEDERAL NAVIGATIONAL RIGHTS).

258 A2d 600-606 (Ct App Md 1969).

Descriptors: *Maryland, *Riparian rights, *Dredging, *Damages, Judicial decisions, Navigable waters, Navigation, Relative rights, Riparian land, Riparian waters, Banks, Channel improvement, Federal government, Compensation, Access routes, Canals, Excavation, Legal aspects, Administrative agencies.

Identifiers: *Right of access, Obstruction to access.

Defendant was under contract with the Army Corps of Engineers to remove mud and debris from a canal by means of a dredge. The materials were pumped to a disposal area through 500 foot lengths of pipe, part of which extended in the water across the front of plaintiff's property. After the dredging was finished, defendant used a cove in front of plaintiff's property to store pipes until they were

floated elsewhere. Plaintiff sued for damages on grounds that his right of access to the water was impaired by the pipes, and the jury returned an award for damages. Upon appeal, the trial court was reversed. The appellate court found that the trial court should have instructed the jury to consider damages only for that period of obstruction not reasonably related to the work of dredging. It stated that the right of access of a riparian owner was subject to the paramount right of the federal government to protect navigation, and that an injury resulting incidentally from such an improvement is not actionable. However, the immunity of the contractor does not protect him from liability for his own negligence if he had full discretion and responsibility for the manner in which the acts causing the injury were carried out. (Doublerley-Florida) W70-05982

POLICE POWER - LANDS - CONSERVATION COMMISSION (IMPROVEMENTS TO WATER-BODIES ON PRIVATE PROPERTY).

For primary bibliographic entry see Field 04D.

W70-05993

CONSERVATION AND PUBLIC PARKS--POLICE POWER (POWERS AND DUTIES OF THE STATE CONSERVATION COMMISSION).

Iowa Code Ann secs 111.3-111.6, 111.18, 111.31, 111.35, 111.53-111.56 (1949), as amended, (Supp 1970).

Descriptors: *Iowa, *Conservation, *Administrative agencies, *Regulation, Lakes, Streams, Access routes, High water mark, Barriers, Islands, Boundaries (Property), Bank protection, Riparian land, Lake ice, Sands, Gravels, Administration, Water conservation, Permits, Legislation, Jurisdiction, Running waters, Piers, Buildings, Docks.

Identifiers: Obstructions.

The State Conservation Commission has the power to maintain, improve or beautify state-owned bodies of water and to provide access routes thereto. No pier, wharf, piling or other erection, except dams, may be built on or over any state-owned water without a permit from the Commission. No structure may be erected in such a manner as to obstruct pedestrian walk-ways between the ordinary high water mark and the water's edge without the Commission's permission. A permit is required to operate any commercial concession on any state-owned waters. The Commission has the power to order the removal of any building or obstruction on state-owned waters if in the best interests of the public. The cost of removal constitutes a lien on the property. The Commission has jurisdiction over all streams and lakes not used by some other governmental body for state purposes. Approval of both the Commission and the executive council is required for the sale of any island in a stream or lake. The Commission may issue permits for the removal of ice, sand, gravel or other materials from waters under its jurisdiction. Banks of lakes and streams cannot be removed without the Commission's permission. (Doublerley-Florida) W70-06012

MASSIE V STATE HIGHWAY COMM'R (EMINENT DOMAIN PROCEEDING).

164 SE2d 696-699 (Va 1968).

Descriptors: *Virginia, *Eminent domain, *Easements, *Compensation, Highways, Condemnation, Legal aspects, Right-of-way, Road construction, Transportation, Highway relocation, Ditches, Judicial decisions, Drainage systems, Local governments, Administrative agencies, Adjudication procedure, Damages.

In a proceeding to acquire land by eminent domain, part of defendant's land was taken for a ditch easement. Defendant was awarded \$6750 for the ease-

ment and as damages for contemplated flooding of a portion of defendant's property. The circuit court held the award excessive and ordered defendant to remit \$6000. The Supreme Court of Virginia reversed on the grounds that the Highway Commission had not determined the damages on the basis of erroneous principles and that the award was not so grossly excessive as to show prejudice or corruption. (Hubener-Florida)
W70-06147

STATE V BROOKS (OBSTRUCTION OF NAVIGATION, OWNERSHIP OF MARSHLAND).
166 SE2d 70-79 (NC 1969).

Descriptors: *North Carolina, *Navigable waters, *Ownership of beds, *Marshes, Estuaries, Streambeds, Beds under water, Salt marshes, Tidal marshes, Relative rights, Riparian rights, Water law, Judicial decisions, Fisheries, Land tenure, Shellfish, Docks, Obstruction to flow, State governments, Legal aspects.

The State of North Carolina brought an action to remove a cloud on title to a marshland and to compel defendants to remove 1500-2000 chicken crates that were placed in navigable streams of the marshland. Defendants answered denying title in the state and claiming title in themselves. The trial court granted judgment in favor of defendants after the jury found that the title to the land was in defendants and that defendants were not obstructing the navigable streams. The court of appeals affirmed. The supreme court reversed and held that the evidence was insufficient to establish that defendants held the land by adverse possession and remanded the question of state ownership to the trial court. The supreme court also held that the issue of whether the crates that were placed in the streams obstructed navigation had been properly submitted to the jury. (Hubener-Florida)
W70-06164

JURISDICTIONAL PROBLEMS: A BARRIER TO THE IMPLEMENTATION AND COORDINATION OF WATER POLICY,
Mississippi Univ., University, Legal Inst. of Agricultural and Resource Development.
Joel Blass.

Mississippi State University Water Resources Research Institute Report, May 1969. 13 p, 30 ref. OWRR Project No A-999-MISS.

Descriptors: *Water law, *Water policy, *Reviews, *Mississippi, Institutional constraints, Interstate, Water allocation (Policy), Water demand, Water resources development, Legislation, Prior appropriations, Riparian rights, Water rights.
Identifiers: Jurisdictional problems (Water law).

State and national water development policies are critically reviewed, using problems and policies in Mississippi as illustrations. The two basic concepts in water law are riparian and appropriation. The greater territorial portion of the U.S. inherited the riparian doctrine from the English. This approach to water law is not suitable except in some areas where there is an abundant supply. Appropriation is also based on the ownership of land, but the right is obtained simply by appropriation and application to some beneficial use. Unlike the riparian right, the right of appropriation may be lost by a liberating prescription through non-use. Mississippi's basic water rights law was originally the riparian doctrine. In 1956 the State Legislature adopted a Surface Water Appropriation Act. Both Mississippi's experience and the example of the State of Oregon indicate that jurisdictional problems may be no real or serious barrier to the implementation and coordination of water policy, but that the various States and the Federal Government have simply not formulated any water policy. The problems, and the waters themselves, frequently cross county and State lines. It is not sufficient that the States alone develop water policies, but the combined resources of the States must be coor-

dinated. The creation of a national water commission and the initiation of a broad analysis of all major aspects of the nation's water problems are suggested. (Knapp-USGS)
W70-06183

REGULATIONS APPLYING TO SPECIFIC VARIETIES OF FISH.

Del Code Ann tit 7, secs 931-936 (1953).

Descriptors: *Delaware, *Fishing, *Commercial fishing, *Nets, Fishing gear, Carp, Trout, Fish management, Estuarine fisheries, Stream fisheries, Fish conservation, Sport fishing, Rivers, Bays, Estuaries, Legislation, Legal aspects, State governments.

Provisions regulate the methods by which carp, herring, rock, shad, sturgeon, mammose, trout and weak fish may be taken in Delaware River or Bay. The size of the fish and the seasons in which they may be caught are also controlled. Penalties and fines are provided for violation of the provisions. (Hubener-Florida)
W70-06191

OUTLAW V OUTLAW (BOUNDARY DISPUTE).
165 SE2d 845-846 (Ga 1969).

Descriptors: *Georgia, *Non-navigable waters, *Boundaries (Property), *Boundary disputes, Water law, Judicial decisions, Legal aspects, Swamps, Marshes, Relative rights, Natural streams, Streams, Natural flow, Watercourses (Legal).

In an action to determine the boundary dividing certain lands, plaintiff contended that the line was the center of a non-navigable stream running through a swampy area known as Beaver Dam Bay. The defendant contended that the line was the north side of Beaver Dam Bay. The deeds designated the boundary only as Beaver Dam Bay. The trial court found for plaintiff. The supreme court affirmed, holding that where land is bounded by a non-navigable stream, the boundary line of such land is the thread of the stream. (Hubener-Florida)
W70-06194

REAL PROPERTY--RIGHT TO FLOAT-FISH THROUGH ANOTHER'S LAND,
Bill Doshier.

Arkansas Law Review, Vol 10, No 1, p 145-149, Winter 1956. 5 p.

Descriptors: *Arkansas, *Missouri, *Riparian rights, *Non-navigable waters, Navigable waters, Rivers, Running waters, Streams, Ownership of beds, Riparian waters, Streambeds, Fishing, Sport fishing, Water utilization, Public rights, Legal aspects, Water law, Water rights, Fly fishing, Judicial decisions, Relative rights.

In a Missouri case plaintiff asserted his right to fish on a stream navigable by canoe but not by larger vessels. The court affirmed this right though defendant had posted and fenced the water enclosed between banks he owned. Application of such a rule to Arkansas would conflict with those precedents restricting public rights to waters navigable in fact. The right to float-fish on a waterway depends on the navigability of the stream. The state owns the beds of navigable waterways. Navigable waterways are by the weight of authority those navigable in fact. The fact that a stream is fishable does not make it navigable. A navigable stream must be navigable for commercial purposes. Some courts in other states give rights to the public in non-navigable streams. These rights are in the nature of an easement for public use. Arkansas does not follow this rule. The Arkansas owner has the exclusive right to fish a non-navigable stream and owns the bed. The Missouri court relied on a statute of the Territory of Missouri, of which Arkansas was a part, granting public rights in such

streams. The statute is obsolete and will not be applied in Arkansas. (Dye-Florida)
W70-06195

REAL PROPERTY - RIPARIAN RIGHTS - ACCRETION, RELICTION, AND AVULSION.
Arkansas Law Review, Vol 6, No 1, p 68-71, Winter 1952. 4p.

Descriptors: *Arkansas, *Accretion (Legal aspects), *Avulsion, *Boundaries (Property), Navigable rivers, Banks, Legal aspects, Legislation, Navigable waters, Relative rights, Severance, Water law, Land tenure, Real property, Bank erosion, Boundary disputes, Riparian land, Judicial decisions, Riparian rights, Shores, Islands.

In an action to quiet title, plaintiff alleged the land in question, on a navigable river, to have been formed by accretion to his land. The land was later separated from the shore by avulsion. Defendant claimed that the land had formed by accretion to his island in the river. The court held that the new land had formed by accretion to the plaintiff's land, but was the defendant's through adverse possession. Accretion is the building up of land by water receding therefrom and filling in by deposits of earth. Avulsion results from a sudden change in the course of a waterway. Land formed by accretion generally belongs to the owner of contiguous land. An Arkansas statute allows such owner to retain title when avulsion separates newly formed land from the owner's original property. Where land forms as an accretion to an island, title does not rest in the owner of the main shore. The concepts of accretion seem to have been correctly applied in the instant case. (Dye-Florida)
W70-06196

LAW OF THE SEA--CONTINENTAL SHELF--GOVERNMENT APPROVAL IS REQUIRED FOR CONSTRUCTION OF ARTIFICIAL-ISLAND NATIONS OFF THE COAST OF FLORIDA.

Virginia Law Review, Vol 55, No 5, p 1005-1011, June 1969. 7 p, 24 ref.

Descriptors: *Florida, *Continental Shelf, *Islands, *Submerged Lands Act, Rivers and Harbors Act, Reefs, Law of the sea, Oceans, Legislation, Judicial decisions, Dredging, Bulkheads, International law, Beds, Beds under water, Federal government, Relative rights, Ownership of beds, Legal aspects, United States, Marine fisheries.

In United States v Ray, 294 F Supp 532 (S D Fla 1969), the defendant attempted by dredging operations to create an artificial island about 5 miles off the Florida coast. The United States intervened to halt the dredging. The district court found that the erection of the island would damage reefs and their marine life and restrained further activity. The court ruled that the Continental Shelf is subject to the exclusive control of the United States on the basis of Presidential Proclamation, the Submerged Lands Act, and the Outer Continental Shelf Lands Act. This law review article cites laws, conventions, treaties and articles on legal aspects of the Continental Shelf and the rights to exploitation of it. There are numerous definitions of the Continental Shelf and numerous authorities and laws which affect the right to ownership and exploitation of the seabed and its natural resources. (Hubener-Florida)
W70-06199

PUBLIC RELATIONS, LAW, ENVIRONMENTAL POLLUTION,
Cleveland State Univ., Ohio.
For primary bibliographic entry see Field 05G.
W70-06200

CONSIDERATION OF ANTICIPATORY USES IN DECISIONS ON COASTAL DEVELOPMENT,
Rhode Island Univ., Providence. Dept. of Political Science.

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Daniel Wilkes.
San Diego Law Review, Vol 6, No 3, p 354-374,
July 1969. 21 p, 60 ref.

Descriptors: *Decision making, *Coasts, *Water policy, *Planning, Competing uses, Bench marks, Future planning (Projected), Sands, Beaches, Recreation demand, Tidal powerplants, Zoning, Coastal marshes, Water zoning, Landfills, Legal aspects, Project purposes, Social needs, Public rights, Environmental effects, National seashores.
Identifiers: *Coastal management systems, Coastal development.

Decisions on coastal development must be based on consideration of possible future uses as well as proposed present uses. The present process for making decisions on coastal development is analyzed. The decisional process used today is geared to rule out consideration of possible future activities on the same location. The factors responsible for this decisional short-sightedness are identified and various solutions suggested. Existing devices available to insure that future activities are not ignored in planning contemporary uses are listed. Creative devices for insuring consideration of future uses in planning decisions are recommended. These special devices are borrowed from other areas and include: ombudsmen for the future; special report sections; historical analyses; and special tribunals. (Cuevas-Florida)

W70-06201

INTERNATIONAL LAW-CONTINENTAL SHELF-PROPRIETARY INTEREST OF UNITED STATES IN CONTINENTAL SHELF PRECLUDES CLAIMS OF ACQUISITION BY PRIVATE ENTREPRENEURS--UNITED STATES V RAY (S D FLA 1969),
Sherry Eckhardt.
San Diego Law Review, Vol 6, No 3, p 487-501,
July 1969. 15 p, 70 ref.

Descriptors: *Continental shelf, *International law, *Oceans, *Ownership of beds, Beds, Law of the sea, Navigation, International waters, Reefs, Legislation, Legal aspects, Judicial decisions, Jurisdiction, Federal jurisdiction, Bulkheads, Dredging, Exploration, Exploitation, Resource development, Construction, Public lands.

In *United States v Ray*, 294 F Supp 532 (S D Fla 1969), the district court enjoined two private corporations' construction of buildings and bulkheads atop coral reefs situated on the continental shelf outside the United States' territorial waters because the construction was destroying irreplaceable natural resources of the seabed. The court held that the reefs were within the territorial jurisdiction of the country. The continental shelf doctrine holds that resources of the seabed and subsoil of the area adjacent to a coastal state are subject to its exclusive jurisdiction and control for purposes of exploration and exploitation. Rights exercised by the United States over the continental shelf are of limited nature. The background of United States' claims to the shelf are given. Through federal legislation dealing with public lands, the United States has applied its territorial legal system to the shelf. This extension of its domestic law underscores United States' dominion over the shelf. Other recent attempts by private entrepreneurs to make use of the continental shelf are cited. Up to now, the United States has never accepted the theory that the shelf is subject to acquisition in a territorial sense. In the future, similar operations may require a showing of shelf ownership by the government before they are thwarted by the courts. (Cuevas-Florida)

W70-06202

SOME LEGAL QUESTIONS ON THE PEACEFUL USES OF OCEAN SPACE.

Denver Univ., Colo. Coll. of Law.
Ved P. Nanda.

Virginia Journal of International Law, Vol 9, No 2,
p 343-407, May 1969. 65 p, 295 ref, 2 append.

Descriptors: *Law of the sea, *Resource allocation, *Water resource development, *International waters, Exploitation, Foreign countries, Governments, Natural resources, Planning, International law, Organizations, Political aspects, Regulation, Ownership of beds, Military aspects, Social aspects, United Nations, International commissions, International waters, Treaties, Institutions, Continental shelf, Oceans.

Identifiers: *Freedom of the seas.

Recent advances in science and technology pose serious challenges to traditional laws and legal institutions. The purpose of this paper is to note current developments in the ocean space arena, especially at the United Nations level. Possible alternatives are evaluated in light of the objectives set by the United Nations General Assembly for utilization of the ocean's resources in the interests of mankind. Four questions are discussed: the extent of national jurisdiction beyond internal waters; alternative legal remedies for deep ocean resources; limits on military uses of the seas; and limitations on freedom of the seas. Freedom of the seas is not an absolute concept. It means each state is free to use the oceans in accommodation with other uses. It has a built-in limitation of reasonable use. There is a need for reaffirmation of this principle of free access to the sea. Some agreement must be reached as to coastal states' right to explore and exploit resources of the ocean floor and its subsoil. An international agency to handle administration of ocean resources lying beyond limits of national jurisdiction is recommended. (Cuevas-Florida)

W70-06203

MAINE LEGISLATIVE RESEARCH COMMISSION: SUBCOMMITTEE REPORT AND PROPOSED LEGISLATION (OIL DISCHARGE PREVENTION AND POLLUTION CONTROL).
For primary bibliographic entry see Field 05G.
W70-06204

CONFERENCE-POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN.

For primary bibliographic entry see Field 05G.
W70-06205

PARK COMMISSIONERS (LAKES IN PUBLIC PARKS).

Iowa Code Ann sec 370.29 (Supp 1970).

Descriptors: *Iowa, *Lakes, *Meanders, *Parks, Boundaries (Property), Legal aspects, Legislation, Taxes, Financing, Administration, Administrative agencies, Conservation, Landscaping, Recreation, State governments, Cities, City planning, Construction, Dikes, Levees, Water supply, Water utilization, Regulation.

Prior to 1880, cities received grants of title to meandered lakes within their corporate limits from the United States. If such lakes are put to public uses, recreation and park purposes for at least twenty years, the boards of park commissioners are authorized to collect an additional tax, not exceeding one mill each year. Such monies are to be used solely for improving such lakes by dredging or otherwise deepening them, constructing dikes and levees, and changing their form and size. The money is also to be used for the regulation, control and improvement of the water supply, the beautification of the lake and surrounding land, and the purchase of equipment for public use and pleasure. (Barnett-Florida)

W70-06239

STATE PUBLICITY (STATE PUBLICITY AND PARKS COMMISSION CREATED).
Ark Stat Ann sec 9-202 (1956).

Descriptors: *Arkansas, *Water resources, *Administrative agencies, *Area redevelopment, Parks, Labor, Legislation, Local governments, State governments, Aesthetics, Conservation, Legal aspects, Regulation, Administration, Land use, Recreation, Natural resources, Labor supply, Industries, Social aspects, Education, Environment, Population, Social change.

A State Publicity and Parks Commission is created as an extension of the State Park System. Its purpose is to encourage the establishment of new industrial enterprise and to expand the tourist industry of Arkansas by promoting the natural resources and other attributes of the state. The Commission is to furnish authentic and favorable information about the state with regard to its: (1) agricultural and industrial possibilities; (2) cultural attainments; (3) historical background; (4) educational, religious, and recreational facilities; and (5) resources and transportation facilities. The Commission shall consist of seven members, two of whom shall be active newspaper or editorial workers or editors. Each congressional district shall be represented on the Commission. (Barnett-Florida).
W70-06240

RECENT DEVELOPMENTS IN WATER LAW (LANDOWNER'S RIGHT TO MAKE REASONABLE USE OF PREMISES),

Clyde, Mecham and Pratt, Salt Lake City, Utah.
Edward W. Clyde.

Natural Resources Lawyer, Vol 1, No 4, p 51-59,
Oct 1968, 9 p.

Descriptors: *Judicial decisions, *Reasonable use, *Federal Reclamation Law, *Relative rights, Legal aspects, Competing uses, Alteration of flow, Natural flow doctrine, Obstruction to flow, prior appropriation, Riparian rights, State governments, Regulation, Dams, Reservoirs, Percolating water, Underground streams, Water pollution, Legislation, Reclamation.

Recent state court decisions that have construed the right of a landowner to make reasonable use of his own land are discussed. Two types of conflicts have arisen over this point. One involves drainage or activity on one's own land which interferes with the water rights of others. The other conflict develops when one seeks to drain his land and to discharge the drainage water on lower lands. After a summary presentation of the holdings of various state courts dealing with the above stated problems, the author goes on to make one further distinction. If two contestants are each contending for the right to use water which can be developed from wells, drains, or development of one's own land, the problem is governed by the rules of water law. When the case involves no competition for the use of the water, but rather is a claim by one landowner that he has a right to make reasonable use of his own land, an entirely different set of rules apply. The article goes on to cite various authorities with regard to the reasonable use doctrine. The 160 acre limitation of the Reclamation Law is discussed in light of cases now pending in the California courts. (Barnett-Florida)

W70-06284

MISCELLANEOUS PROVISIONS FOR THE REGULATION AND PROTECTION OF FISH AND GAME.

Tenn Code Ann secs 51-501 thru 51-513 (1966).

Descriptors: *Wildlife conservation, *Tennessee, *Fish, *Regulation, Administrative agencies, Wildlife, Birds, Game, Fishing, Hunting, Pike, White bass, Trout, Fish ladders, Permits, Bodies of water, Lakes, Rivers, Streams, Docks, Dams, Water pollution, Refuse, Legislation, Legal aspects.

Except as provided, the purchase, use, possession of, and traffic in protected game and fish are prohibited. Anyone desiring to take protected game or fish must comply with regulations concerning licensing, limitations on quantity, and

procedures for shipping. The duties of persons shipping game or fish or placing such in cold storage are outlined. Licensed wholesale dealers may purchase certain fish from out-of-state sources but must notify the Director of the Game and Fish Commission of such purchases and keep records for inspection. The private use of state-owned waters and bordering lands is regulated. All owners of dams constructed across streams must, if necessary for the free passage of fish, erect fish ladders. Specified locks and dams across large rivers, and dams which produce electricity, are exempted from this requirement. Pollution injurious to fish life in public or private waters is prohibited. Continued violation of this water pollution provision constitutes a public nuisance subject to abatement by permanent injunction. (Duss-Florida)

W70-06285

PUBLIC ATTITUDES TOWARD WATERSHED MANAGEMENT,

N. E. Spangenberg.

Journal of Soil and Water Conservation, Vol 24, No 6, p 232-234, Dec 1969. 3 p, 2 ref.

Descriptors: *Water policy, *Administration, *Watershed management, Forest management, Water management (Applied), Water supply, Water sources, Water quality, Water quality control, Water resources, Planning, Water resources development.

Public response to professional watershed management may restrict the planning activities of managers. A survey of watershed managers indicates that public response is limited to one to five percent of the residents of a watershed and is concerned with the quality of water at the tap rather than management policy. Questionnaires were sent to city water managers and national forest supervisors in six western states, questioning them as to the quantity and quality of complaints addressed to them as water managers. The results indicated that the public is interested in watershed management only in cases of water quality emergencies—changes in color, odor, or taste of water at the tap. City managers received complaints, largely in the form of telephone calls, whereas forest managers received complaints by letter, perhaps as a result of unavailability. A greater quantity of response was noted by forest managers. Water managers should make the public more conscious of the water resource and its relation to the community in order to secure funds to implement water policies. (Dye-Florida)

W70-06286

WHO OWNS THE MINERAL RIGHTS IN HU- SON BAY,

Charles Birt.

Manitoba Law Journal, Vol 3, No 2, p 41-52, 1969.

12 p, 25 ref.

Descriptors: *Bays, *Water rights, *Water law, *Ownership of beds, Riparian rights, Legislation, Legal aspects, Preferences (Water rights), Prior appropriation, Boundaries (Property), Boundary disputes, Low water mark, Bodies of water, Governments, Judicial decisions, International law, Internal water, Mineralogy, Foreign waters, Relative rights.

Identifiers: Canada.

The Royal Charter of 1670 granted to Hudson's Bay Company only specified mineral rights, i.e., gold, silver, gems and precious stones. All other rights were retained on behalf of the Crown. The British North America Act of 1867 transferred the limited mineral rights of the Hudson's Bay Company to Canada. The complete transfer of mineral rights did not occur until 1880 when Britain gave up her last remaining possessions in Canada. The federal government on behalf of Canada became the possessor of these mineral rights. Canada claims, under international law, that Hudson Bay is 'internal' water under the Historic Bay Principle. Canada, i.e., the federal government, has never

transferred these mineral rights to either Ontario, Quebec or Manitoba. Their boundaries were extended in 1912 to the low water mark of Hudson Bay. The provinces were given the mineral rights that lay within their boundaries but nothing was ever said about Hudson Bay. Therefore, the federal government retained them for Canada. The legal position today is that Canada owns the mineral rights in the sea bed of Hudson Bay. (Powell-Florida)

W70-06288

ON THE NON-UTILITY OF DOMESTIC WATER TRANSPORT REGULATION,

Pennsylvania State Univ., University Park. Dept. of Business Administration.

John C. Spychalski.

ICC Practitioner's Journal, Vol 37, No 1, p 7-20, Nov-Dec 1969. 14 p, 63 ref.

Descriptors: *Water conveyance, *Water transfer, *Transportation, *Regulation, Legal aspects, Inland waterways, Railroads, Ships, Canals, Pipelines, River regulation, Administrative agencies, Federal government, Political aspects, Economics of scale, Economics, Economic impact, Economic justification, Economic feasibility, Water law.

Part III of the Interstate Commerce Act subjects domestic for-hire freight and passenger traffic on rivers and canals, the Great Lakes, and coastal and intercoastal ocean routes to economic regulation by the Interstate Commerce Commission. Such regulation is assessed with regards to economic and environmental aspects of domestic water transportation. The causes and content of water carrier regulation, including the conditions leading to Part III's enactment and the major provisions of Part III, are reviewed. Economic justification of water carrier regulation depends upon its contribution to the achievement of several objectives: (1) the avoidance of monopoly profits; (2) the efficient performance of inland water transport firms; (3) a sufficient supply of water transport services; and (4) the prevention of cutthroat competition. The price system's ability to fulfill the above objectives without intervention by Commission regulation is demonstrated. Formidable economic barriers do not confront the firm contemplating entry into inland water transport. The nature of domestic water transport's demand and cost conditions prevents the typical water carrier firm from generating monopoly profits. The regulation-immune movement of certain water-borne freight under terms of the bulk and liquid exemptions empirically demonstrates the workability of unregulated water carrier competition. Available evidence indicates that economic regulation of domestic water transport should be eliminated. (Powell-Florida)

W70-06289

POLLUTION, LAW, SCIENCE, AND DAMAGE AWARDS,

For primary bibliographic entry see Field 05G.

W70-06290

THE STATUS OF MINERAL RESOURCES ON THE OCEAN FLOOR.

California Western Law Review, Vol 5, No 2, p 299-312, Spring 1969. 14 p, 85 ref.

Descriptors: *Oceans, *Resource allocation, *Mineralogy, *Ownership of beds, Resources, Mineral industry, Mining, Legal aspects, Geology, Resource development, Water resources development, Land resources, Natural resources, Conservation, Continental slope, Continental shelf, Law of the sea, Shores, Appropriation, Riparian rights, Water rights, Beds under water, Regime, Coasts, Internal waters, Water types.

Allocations of jurisdiction and control over the ocean are surveyed. The ocean is traditionally divided into five zones: (1) internal waters; (2) territorial sea; (3) contiguous zones; (4) continental

shelf; and (5) high seas. Each zone is defined and discussed. The oceans should be divided in terms of the geological structure of the ocean bottoms which includes: (a) the continental shelf; (b) the continental slope; and (c) the deep ocean floor. There is a need for a legal system to determine the sovereignty or control over the minerals on the continental shelves and deep sea areas of the world. There are two general theories dealing with the status of the mineral resources of the deep sea floor. One theory treats these minerals as the common property of the international community and incapable of appropriation by any one nation. The second theory treats these minerals as belonging to no one and therefore subject to acquisition by individual nations. Other possible theories of allocation of mineral resources include: (1) the unlimited extension of the continental shelf; (2) literal extension of the doctrine of the Convention on the Continental Shelf; (3) the flag state theory; and (4) the international agency theory. The extent of the coastal state's ownership of minerals adjacent to its coast should be to the foot of the continental slope. Beyond the slope the appropriation and status of the mineral resources should be controlled by a regime of the deep sea. (Powell-Florida)

W70-06291

NAVIGABILITY IN THE MISSOURI RIVER BASIN,

Alvin E. Bielefeld.

Land and Water Law Review, Vol 4, No 1, p 97-119, 1969. 23 p, 106 ref.

Descriptors: *Missouri River, *Navigable rivers, *River basins, *River basin development, River regulation, River beds, Impoundments, Irrigation systems, Electric power-plants, Federal states water rights conflicts, Federal reservations, Reservoir operation, Competing uses, Conservation, Prior appropriation, Indian reservations, Federal government, State governments, Regulation, Judicial decisions, Legal aspects, Ownership of beds. Identifiers: *Missouri River Basin.

Navigability has a significant effect on the development of the Missouri River Basin. The physical characteristics of navigability are reviewed and the methods of showing navigability by physical characteristics are discussed. Incidents of navigability, such as the commerce servitude and state ownership of beds, are explored. An examination of the consequences of navigability of streams is made in light of the Flood Control Act of 1944 and other applicable legislation. The instances of cooperation and conflict between the states and the federal government as a result of a finding of navigability in general are also examined. Finally, an examination is made of the rights of the various Indian tribes in federally reserved beds and water of the Basin. (Barnett-Florida)

W70-06294

RECENT DEVELOPMENTS AFFECTING PUBLIC LANDS OF THE STATES—1968,

Owen Olpin.

Natural Resources Lawyer, Vol 2, No 3, p 229-237, July 1969. 8 p, 46 ref.

Descriptors: *Navigable waters, *Riparian rights, *Ownership of beds, *Accretion (Legal aspects), Judicial decisions, Legislation, Riparian waters, Boundaries (Property), Eminent domain, Condemnation, Federal government, Beaches, Shores, Recreation, Mineralogy, Oil, Natural gas, Natural resources, Legal aspects, Mining.

In 1968 there were a number of important judicial and legislative developments affecting navigable waters and adjoining uplands. The cases involving ownership of beds of navigable waters were decided upon the principles that new states are admitted on an equal footing with the other states and that the United States holds title to beds of navigable waters in trust for future states. Two cases involving accretion determined that the owner of the land bounded by navigable water acquired the

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

rights to any natural and gradual accretion formed along the shore. In a seaward boundary case in Hawaii, an upland owner was held entitled to accretions resulting from violent volcanic action. In the area of open beach laws, Hawaii has accomplished by judicial decision what Oregon has attempted by its Beach Bill. Offshore oil, gas and mineral exploration was the subject of a Mississippi constitutional amendment. The settlement of native land claims was the subject of statutory and case law in Alaska. The Utah Supreme Court held that the multiple use amendment to that state's mineral leasing laws prohibited the issuance of an oil and gas lease on state lands already covered by a bituminous sands lease. The Nevada Supreme Court implicitly recognized the right of private condemnation for mining purposes provided there is a fair and proper method for computing the amount to be paid to the owner for his land. (Powell-Florida)
W70-06296

NOTES ON VIRGINIA WATER LAWS AND AGENCIES.

Virginia Dept. of Conservation and Economic Development, Richmond, Va. Div. of Water Resources.

Dept of Conservation and Economic Development, Revised 1964. 34 p.

Descriptors: *Virginia, *Water law, *Judicial decisions, *Legislation, Administrative agencies, Federal government, Surface waters, Legal aspects, State governments, Local governments, Groundwater, Navigable waters, Riparian waters, Riparian land, Diversion, Soil conservation, Water conservation, Drainage districts, Water resources.

Much of the water law of Virginia is case law which is not fully developed. Significant Virginia court decisions affecting both surface and groundwater are enumerated and annotated. Surface water cases involve diversion, navigability, riparian land, riparian rights and property rights. Groundwater decisions cover definition, rights and diversion. Statutory provisions affecting water resources are listed. The subject matter of such provisions is arranged according to the individual, agency or governing body having the authority, the right, or the responsibility indicated. Statutes relating to Soil and Water Conservation Districts, Sanitary Districts, Water and Sewer Authorities, Public Facilities Districts, Sanitation Districts, and Drainage Districts are discussed. Water resources statutes concerning counties, cities and towns, the Commonwealth, the Governor and the courts are surveyed. Water law provisions involving the State Corporation Commission, the Commission of Fisheries, the Commission of Game and Inland Fisheries, the Highway Commission, the Soil and Water Conservation Commission, the Potomac River Basin Commission and the Ohio River Valley Water Sanitation Commission are presented. Virginia water law statutes relating to the Department of Conservation and Economic Development, the Division of Water Resources, the Division of Mineral Resources, the Virginia State Ports Authority, the State Water Control Board, the Department of Health and the Advisory Council on the Virginia Economy are examined. (Powell-Florida)
W70-06297

RECENT DEVELOPMENTS IN INTERNATIONAL ENVIRONMENTAL POLLUTION CONTROL,

For primary bibliographic entry see Field 05G.
W70-06298

CONFERENCE COMMITTEE, NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, HR REP NO 91-765, 91ST CONG, 1ST SESS.
For primary bibliographic entry see Field 05G.
W70-06299

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION,

Gary D. Weatherford.

U C L A Law Review, Vol 15, No 5, p 1299-1346, Sept 1968. 47 p, 227 ref.

Descriptors: *California, *Water allocation (Policy), *Riparian rights, *Equitable apportionment, Watershed protection, Alteration of flow, Competing uses, Legal aspects, Legislation, Prior appropriation, Reasonable use, Relative rights, Water sources, Water utilization, Resource development, Beneficial use, Diversion, Priorities, Area development, Federal government, Institutions, Interstate, State governments, Economic efficiency.

This article deals with inter-regional water diversion and the division of water between claimants who are comparatively close to and distant from the water's edge. Close attention is paid to the development of riparian water law in the western states, as affected by the imposition of regulations by the state legislatures. This legal development is first illustrated by a discussion of California's regulation of the diversion of waters from northern basins to the south and then by a survey of regulations in seven other western states. Attention is given the treatment of water rights between co-riparian states and between riparian and non-riparian states. Consideration is given to the applicability of the doctrine of area-of-origin and to the requirement of diligent water use, illustrated by reports on the Colorado River Basin Act, the National Water Commission Act, and the Northwest-Southwest hydro-power intertie. The economic problems of regional protection of water are discussed. An appendix is included which contains recommendations for reciprocal protection and regulation of intrastate and interstate water allocation. (See also W70-06301 thru W70-06306). (Dye-Florida)
W70-06300

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (DEVELOPMENT OF WESTERN AND CALIFORNIA WATER ALLOCATION LAW),

Gary D. Weatherford.

U C L A Law Review, Vol 15, No 5, p 1299-1311, Sept 1968. 13 p, 58 ref.

Descriptors: *California, *Prior appropriation, *Riparian rights, *Water allocation (Policy), Watershed protection, Alteration of flow, Competing uses, Legal aspects, Legislation, Relative rights, Water law, Water sources, Resource development, Diversion, Area development, State governments, Water demand, Administration, History, Water requirements, Irrigation water, Water shortage, Water supply, Priorities.

Conflicts between areas of origin (where water originates) and areas of delivery (where water is exported from its natural watershed) have been settled in western water law by resort to the doctrines of prior appropriation and riparian rights. Prior appropriation gives rights in water to whoever first uses it. Riparian law cedes rights to owners of land adjacent to natural watercourses and normally does not allow its diversion from the watershed. Prior appropriation early gave way in California to a modified riparian system whereby water could be diverted only when not of beneficial use to claimants within the watershed. Increased water needs in the West led to state administration of water distribution, sometimes limited to water not previously in beneficial use. In the 1920's California enacted statutes designed to utilize the surplus water of the Sacramento River in the semi-arid San Joaquin Valley. Amendments to the statutes limited diversion to water unnecessary for the development of the area of its origin. Riparian water-needs developing after state diversion were accorded priority over needs outside the watershed. (Dye-Florida)
W70-06301

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (INTRASTATE DIVERSION OF WATER FROM AREAS-OF-ORIGIN IN THE WEST),

Gary D. Weatherford.

U C L A Law Review, Vol 15, No 5, p 1311-1317, Sept 1968. 7 p, 35 ref.

Descriptors: *California, *Water allocation (Policy), *Watershed protection, *Equitable apportionment, Diversion, Riparian rights, Competing uses, Legal aspects, Legislation, Prior appropriation, Relative rights, Water sources, Resource development, Area development, Water demand, Priorities, Water requirements, State governments, Arizona, Colorado, Nebraska, Oklahoma, Oregon, Texas, North Dakota.

The State Water Project of the early 1950's, designed to transport surplus northern water to southern California, focused attention on the county-of-origin and watershed-of-origin provisions of the California Water Code. Southern interests proposed bills to secure water contracts under the program, while northern interests demanded protection for their water supplies. The result was a law securing water contracts while the bonds financing the project were outstanding, and providing funds for development of water resources in the areas of origin. Arizona, Colorado, Nebraska, Oklahoma, Oregon and Texas provide protection for the needs of areas of origin by statute. North Dakota allows more liberal diversion of water from natural watersheds. All these states allow diversion of water under clear conditions of surplus. Some require the consent of local water boards as a condition of diversion from the boards' areas. (Dye-Florida)
W70-06302

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (INTERSTATE WATER DISPUTES; AREA-OF-ORIGIN AND STATE-OF-ORIGIN DOCTRINES),

Gary D. Weatherford.

U C L A Law Review, Vol 15, No 5, p 1317-1323, Sept 1968. 7 p, 29 ref.

Descriptors: *Water allocation (Policy), *Interstate, *Riparian rights, *Prior appropriation, Watershed protection, Competing uses, Legal aspects, Reasonable use, Relative rights, Water law, Watersheds (Basins), Diversion, Area development, Institutions, State governments, Resource development, Water demand, Water sources, Judicial decisions, Water utilization, Equitable apportionment.
Identifiers: *Interstate conflicts.

Disputes between co-riparian states often arise, where the boundary line between the states cuts through a common watershed, when diversions by the upstream state reduce water flow to the downstream state. As between states sharing the natural advantage of a watercourse, a claim to preferential treatment on watershed-of-origin grounds has not been recognized by the courts. Under the prior appropriation doctrine water rights are perfected by diligent use and lost by non-use. Diligent use is important in that injunctive relief may be denied without a showing of present injury; without a showing of present use, injury will be difficult to establish. Riparian theory allows preservation of rights in surplus water for future use. Early cases applied the principle of state sovereignty to cases involving the diversion of intrastate water to states outside the watershed of origin. Later cases have held that state restrictions of diversion unduly burden interstate commerce. (Dye-Florida)
W70-06303

LEGAL ASPECT OF INTERREGIONAL WATER DIVERSION (INTERSTATE WATER DIVERSION—LEGAL DEVELOPMENTS),

Gary D. Weatherford.

U C L A Law Review, Vol 15, No 5, p 1323-1334, Sept 1968. 12 p, 68 ref.

Descriptors: *Interstate, *Water allocation (Policy), *Equitable apportionment, *Legislation, Watershed protection, Riparian rights, Legal aspects, Competing uses, Relative rights, Water law, Watersheds (Basins), Water sources, Water utilization, Resource development, Diversion, Area development, Institutions, State governments, Political aspects, Hydroelectric power, Water demand, Federal government, Water utilization, California, Regions.

The Pacific Southwest Water Plan, designed to divert California water into Arizona, aroused opposition in California. As the state-of-origin, California desired explicit guarantees that the cost of water development in California would not increase as a result of the Plan. The Plan failed to become law. When the Colorado River Basin Project Act was first introduced, it embodied the California Pacific-Southwest-Plan requests. The Northwestern states, from which the water was to be diverted, protested that the guarantees accorded them were not sufficient. The Act was re-introduced bearing guarantees of federal funds to insure low-priced water in areas-of-origin. There was also provision for establishing a National Water Commission to evaluate the needs of areas-of-origin and areas-of-delivery and to develop comprehensive plans for the solution of water problems. Stringent area-of-origin protection is also included in the development of the Pacific Northwest-Pacific Southwest hydro-power intertie. Power generated by rivers in the Northwest may be delivered outside the region only to the extent that such power exceeds the needs of the regions wherein the power-generating water originates. (Dye-Florida)

W70-06304

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (ECONOMIC FACTORS AFFECTING INTERREGIONAL WATER DIVERSION),

Gary D. Weatherford.

U C L A Law Review, Vol 15, No 5, p 1343-1343, Sept 1968. 10 p, 37 ref.

Descriptors: *Water distribution (Applied), *Water allocation (Policy), *Economic efficiency, *Diversion, Economics, Marketing, Watershed protection, Riparian rights, Competing uses, Legal aspects, Legislation, Relative rights, Water sources, Water utilization, Resource development, Priorities, Area development, Federal government, State governments, Regions, Water rights, Appropriation, Political aspects, Government finance, Contracts.

The region-of-origin restrictions placed upon water diversion probably must be viewed as impediments to economic efficiency in water distribution. Free market conditions do not prevail in federal water resource development. Guaranteed subsidies for regions of origin serve much the same purpose as revenues from sales of water would in a market economy. Increased transferability of existing rights in appropriated waters might lead to a more economic allocation of water resources. The same theory might also be applied to presently unappropriated waters if these waters were apportioned among the riparian states; the states could then transfer them by sale. Such sales would involve constitutional issues if water is priced so high as to burden interstate commerce. Such a system would also require more precise definitions of regional public, deficiency, surplus, and need. Political allocation is likely to continue, but the national public interest should be an increasingly important factor in its development. (Dye-Florida)

W70-06305

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (RECOMMENDATIONS FOR REGULATION OF INTERREGIONAL WATER ALLOCATION),

Gary D. Weatherford.

U C L A Law Review, Vol 15, No 5, p 1343-1346, Sept, 1968. 4 p.

Descriptors: *Equitable apportionment, *Water allocation (Policy), *Water distribution (Applied), *Diversion, Watershed protection, Riparian rights, Competing uses, Legal aspects, Legislation, Relative rights, Watersheds (Basins), Water sources, Resource development, Water utilization, Priorities, Area development, Federal government, Institutions, State governments, Political aspects, Government finance, Regions, Economic efficiency, Allotments, Coordination.

The following recommendations are based on assumptions that: (1) the transfer of water from one region to another is imminent and (2) the transfer will result from federal-state cooperation in a subsidized-price-water economy. Vested and subsisting water rights should be identified. Future water needs of each region should be estimated and reserve allotments from water originating in each region should equal these needs. Water exceeding the reserve allotment should be available for export. Reserve and export allotments should be fixed for the term of amortization of diversion facilities. Priorities of use should be established. The point of diversion should be selected with regard to priorities and economic efficiency. Both original and delivery regions should practice water conservation. Legal impediments to water transfer should be ameliorated by the states. Regions of delivery should establish regional guarantee funds payable to the regions of origin on the occurrence of new water needs. New allotments and priorities should be determined prior to the end of the established allotment term. The system should be implemented both between the states and under the aegis of the federal government. (Dye-Florida)

W70-06306

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT,'

Michael V. McIntire.

Land and Water Law Review, Vol 5, No 1, p 23-48, 1970. 26 p, 91 ref.

Descriptors: *Wyoming, *Water rights, *Prior appropriation, *Adjudication procedure, Appropriation preferences (Water rights), Competing uses, Irrigation, Non-structural alternatives, Regulation, Relative rights, Water allocation (Policy), Water contracts, Water law, Water utilization, Diversion, Water permits, Withdrawal, Irrigation water, Water users, Water demand.

The appropriation system of water rights in Wyoming has been ineffective in large part because of inaccurate records that do not reflect actual water practices in the state. Many of the reasons for the discrepancies are described, along with the consequences that inaccurate records impose on the state and on the holders of water rights. A number of failures in the current scheme are disclosed and a number of possible changes in water law and policy are pointed to. Three solutions are outlined, along with the possible problems, advantages and disadvantages of each. Some administrative changes are recommended, and a method of financing the schemes is suggested. (See also W70-06308 thru W70-06310). (Doublerley-Florida)

W70-06307

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT.' (THE EXTENT OF THE PROBLEM),

Michael V. McIntire.

Land and Water Law Review, Vol 5, No 1, p 23-30, 1970. 7 p, 34 ref.

Descriptors: *Wyoming, *Water permits, *Water users, Preferences (Water rights), Water rights, Adjudication procedure, Appropriation, Prior appropriation, Administrative agencies, Competing uses, Irrigated land, Irrigation, Regulation, Relative rights, Water allocation (Policy), Water contracts, Consumptive use, Diversion, Use rates, Withdrawal, Irrigation water, Riparian rights, Usufructuary right.

Water rights in Wyoming have been granted upon proofs submitted by users which contain information concerning the nature and the extent of the use. These records are an inaccurate reflection of actual water use because of inaccuracies in filings and subsequent unrecorded changes in use. The State Engineer has been unable to eliminate unused water rights, and there exists the possibility of the resurrection of an unused right which might affect the source of water for the owner of a subsequent right. Under the appropriation system, early priority rights are protected, so the holder of a water right remains uncertain of his actual rights. This uncertainty discourages new development, precludes an effective state water plan, and affects dealings with other states and the federal government. Discrepancies in the record result from insufficient water to irrigate the lands described, and practice of irrigating less land than the records show, inaccuracies in land description and in descriptions of the nature of the use, and inaccurate descriptions of points of diversion. (Doublerley-Florida)

W70-06308

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT.' (ANALYSIS OF THE PROBLEM AND CRITERIA FOR A SOLUTION),

Michael V. McIntire.

Land and Water Law Review, Vol 5, No 1, p 30-37, 1970. 7 p, 34 ref.

Descriptors: *Wyoming, *Water rights, *Water allocation (Policy), *Water permits, adjudication procedure, Appropriation, Preferences (Water rights), Prior appropriation, Administrative agencies, Competing uses, Non-structural alternatives, Regulated flow, Regulation, Relative rights, Water law, Non-consumptive use, Consumptive use, Recreation, Beneficial use, Construction, Water demand, Groundwater, Surface-groundwater relationships, Usufructuary right.

Identifiers: Abandonment (Water rights).

Many discrepancies in the Wyoming water use records are the result of users over-estimating the amount of land to be irrigated. The legislature has failed to provide the State Engineer with adequate funds or personnel to enforce water rights or with workable enforcement procedures. Abandonment proceedings for unused rights are complicated and expensive. Detections of water use violations are difficult, and sanctions are ineffective. Unconstructed permits present problems because they allow the permittee to delay completion of construction and still take advantage of the early priority of his original permit. Maintaining accurate records of water users and water rights requires bringing the records and water use patterns into harmony, devising ways of maintaining accurate records, and delineating the purpose and goals of water law in light of changing needs. Water laws must change to meet changes in the population and economics. Limitations on water rights may have to vary with the use and the place of the use. The concept of beneficial use may be expanded to include non-consumptive and recreational uses. Correlation of surface and groundwater rights may be necessary. (Doublerley-Florida)

W70-06309

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT.' (POSSIBLE SOLUTIONS),

Michael V. McIntire.

Land and Water Law Review, Vol 5, No 1, p 37-48, 1970. 11 p, 22 ref.

Descriptors: *Wyoming, *Water rights, *Adjudication procedure, *Water permits, Appropriation, Preferences (Water rights), Prescriptive rights, Prior appropriation, Administrative agencies, Competing uses, Equitable apportionment, Taxes, Non-structural alternatives, Regulated flow, Regulation, Water allocation (Policy), Water law, Water utilization, Non-consumptive use, Use rates, Water users, Water demand.

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One solution to the Wyoming water use problem would require that appropriators conform water uses to those shown on existing records. It would probably require new legislation, although existing agencies arguably possess the requisite power now. Such strict enforcement scheme would be met with legal obstacles of laches and estoppel, and it would have a disruptive social and economic impact by upsetting existing long-time water uses. A second solution would require that records be changed to conform to existing uses. A curative act would allow for validating currently unauthorized uses. Surveying water uses would be expensive and lengthy, and there is no provision for change. The third solution would ratify existing uses for a period of time with provisions for abandonment of unused rights. Water rights would be renewable, but subject to changing laws and conditions. For water law administration, the state needs more money, more personnel, and improved methods of obtaining water use data. The program could be financed through a water use tax in conjunction with a report filed by the user. (Doublerley-Florida)
W70-06310

6F. Nonstructural Alternatives

FLOOD HAZARD INFORMATION, POTOMAC RIVER AND TRIBUTARY STREAMS, STAFFORD COUNTY, VIRGINIA.
Corps of Engineers, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W70-05918

URBAN HYDROLOGY, STORM DRAINAGE, AND FLOOD PLAIN MANAGEMENT IN METROPOLITAN AREAS OF THE UNITED STATES,
American Public Works Association, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-05960

ZONING FOR FLOOD DAMAGE MITIGATION,
New South Wales Univ., Kensington (Australia).
C. H. Munro.
New South Wales University Water Research Laboratory Technical Report No 69/2, January 1969. 10 p, 1 tab.

Descriptors: *Flood plain zoning, *Economics, *Flood damage, Costs; Flood protection, Non-structural alternatives, River basin development, Water resources development.
Identifiers: Liverpool (Australia), New South Wales.

If residential development is permitted on all lots in the area under consideration in Liverpool, New South Wales, Australia which are above the flood level of 20 year recurrence interval, the average annual damage of houses in the lowest level in the area will approximate \$15.00 per annum per house in 1968 money values. Obviously a prospective home buyer would much prefer to bear this small cost in order to live in an area close to the thriving commercial center of Liverpool, with all its desirable amenities of schools, hospitals, transport system, shopping centers and the like, rather than to be forced to go to areas more distant from these facilities. In the Town Plan of the Liverpool City Council, residential development should be permitted on all land which is not flooded by the flood of 20 years recurrence interval. (Knapp-USGS)
W70-06146

FLOOD WARNING BENEFIT EVALUATION - SUSQUEHANNA RIVER BASIN (URBAN RESIDENCES),
Weather Bureau, Silver Spring, Md. Office of Hydrology.
Harold J. Day.
ESSA Technical Memorandum WBTM HYRO 10, March, 1970. 42 p, 5 tab, 12 fig, 15 ref, 2 append.

Descriptors: *Flood damage, Evaluation, Flood proofing, Flood plains, Warning systems, *Non-structural alternatives.
Identifiers: *Flood warnings, *Susquehanna River Basin, Evacuation.

The effectiveness of a warning service, in urban areas only, coupled with either temporary flood proofing or evacuation of residential structures in reducing flood damage, is the subject of this report. Communities in the floodplain of the Susquehanna River Basin in New York, Pennsylvania, and Maryland were used for a computer simulation of flood-related action. For the 116 reaches of the river system investigated, flood damage to residences - without any warning - was estimated to be No. 3 million (expected annual cost). Reducible damages represented one-third of this value \$1 million. Reliable warnings, allowing 6 to 12 hours of action time, could be expected to provide at least two-thirds of the reducible damage as net benefits. Evacuation was generally economically advantageous compared to temporary flood proofing. Efficient local disaster organizations and total public response and compliance with action decisions are assumed. Loss of life has not been included. (Stahl-ESSA)
W70-06182

6G. Ecologic Impact of Water Development

FERTILITY OF THE BURBOT (LOTA LOTA L.) IN RYBINSK RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Narragansett, R.I. Narragansett Marine Game Fish Research Lab.
V. M. Volodin.

Translation of the Narragansett Marine Game Fish Research Laboratory, Bureau of Sports Fisheries. Available from the Clearinghouse as PB-189 284T, \$3 in paper copy, 65 cents in microfiche. In: Akademiya Nauk, SSR, Institut Biologii vnutrennikh vod, trudy, no 17-20, Nauka, 1969, pp 222-229.

Descriptors: *Fish behavior, Fertilization, Aquatic habitats, Fish farming, Reservoir operation.
Identifiers: *Burbot (Lota Lota L.).

The absolute fertility of the burbot, as well as many other species of fish, grows regularly with increase in the sizes of fish; at the same time the relative fertility depends little on the size of fish, at least a correlative connection between these characters was not established for the Rybinsk population. Both the absolute and relative fertility of equal-size individuals of the burbot vary extremely, in which the difference in the extreme values can be very great. The average fertility of a group of equal-size individuals is not a constant quantity and changes from year to year. Fertility is deeply connected with the conditions of existence of the fish. Size of the eggs practically does not depend on the size of the fish, however, the fluid content of the egg increases somewhat with increase of the absolute fertility. The diameter of the egg remains unchanged with increase of relative fertility, but the weight of the egg decreases regularly; this decrease occurs due to decline in the amount of yolk in the eggs, whereas the relative amount of water in it remains constant.
W70-05974

THE DELAWARE VALLEY ENVIRONMENT: STATUS AND PROSPECTS.
Greater Philadelphia Chamber of Commerce, Pa.; and University City Science Center and Inst., Philadelphia, Pa.

Earth Week Technical Symposium held in Philadelphia, Pennsylvania, April 4-10, 1970. 184 p, 4 fig, 24 tab, 108 ref.

Descriptors: *Water pollution effects, *Water pollution control, *Air pollution, *Environmental ef-

fects, *Urbanization, Ecology, Environment, Delaware River, Waste disposal, Radioactivity, Systems analysis, Planning, Water law, Legislation, Social aspects, Population, Human population.
Identifiers: Delaware River Basin.

A Technical Symposium was held in conjunction with the activities sponsored by the Earth Week Committee of Philadelphia. Seeking a dramatic impact on the environmental conscience of the nation, a prime purpose of the nationwide Earth Week effort is to arouse public opinion on necessary steps to protect our environment. To achieve this goal of education these technical symposia brought together experts on environmental matters from universities, government, and the corporate community in the Philadelphia Region. One key purpose was to develop an inventory and status report on environmental problems in the Philadelphia or Delaware Valley Region. Emphasis was placed on the interrelationships and interdependences among environmental problems, particularly because the focus of discussions is a major metropolitan area with an enormous range of environmental interactions. (Knapp-USGS)
W70-06101

ECOLOGICAL IMPLICATIONS OF RIPARIAN VEGETATION MANAGEMENT,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W70-06103

DISTINCTIVE ASPECTS OF THE ECOLOGY OF STREAM FISHES: A REVIEW,
Fisheries Research Board of Canada, Nanaimo (British Columbia). Biological Station.
K. Radway Allen.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1429-1438, 1969. 1 fig, 17 ref.

Descriptors: *Fish, *Streams, *Ecology, Fish behavior, Food habits, Streamflow, Fish reproduction, Metabolism, Reviews.
Identifiers: Trout zone, Grayling zone, Barbel zone, Bream zone, *Salmo trutta*, *Thymallus thymallus*, *Barbus barbus*, *Abramis brama*, Fish fauna, Rapid streams, Fish social behavior.

In descending order of average current velocity, streams have been divided by Huet into four zones: trout, grayling, barbel and bream. Classification of North American streams (Lagler) has resulted in five similar zones. Such classifications often confuse or ignore such effects as climate, distribution and environmental requirements. Characteristics of fish inhabiting the trout and grayling zones are considered exclusively. Such fish have higher oxygen requirements and concomitant high lower lethal oxygen limits. They tend to have either streamlined or flattened body shapes which allow for maintenance of position in the current. Reproduction involves burying eggs in the stream bed, with or without definite nest-building. Principal dietary components are bottom fauna, small fishes and autochthonous and allochthonous drift. For the most part, such fishes are solitary and sometimes strongly territorial; schooling behavior is rare. A notable exception is the Japanese ayu, *Plecoglossus altivelis*, which feeds on attached algae and exhibits schooling behavior when population densities rise above a critical level. (Voigtländer-Wisconsin)
W70-06220

SOME EFFECTS OF THE KISSIMMEE RIVER CHANNELIZATION ON THE FISHERY RESOURCE,
For primary bibliographic entry see Field 05C.
W70-06287

07. RESOURCES DATA

7A. Network Design

DEEDS AND DATA,

For primary bibliographic entry see Field 05D.
W70-06078

ANALYSIS OF A 24-YEAR PHOTOGRAPHIC RECORD OF NISQUALLY GLACIER, MOUNT RAINIER NATIONAL PARK, WASHINGTON, Geological Survey, Washington, D.C.

Fred M. Veatch.

Report for sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Geological Survey Professional Paper 631, 1969. 52 p, 39 fig, 1 plate, 1 tab, 13 ref.

Descriptors: *Glaciers, *Surveys, *Photography, *Washington, Mapping, Terrain analysis, Geomorphology, Melting, Regimen, Movement, Scour, Snowpacks, Glaciation, Data collections. Identifiers: Nisqually Glacier, Mount Rainier.

A systematic coverage of Nisqually Glacier by photographs taken from a network of stations on the ground was begun in 1942 to explore the value and limitations of such photographs as an aid in glacier study. Nisqually Glacier in Mount Rainier National Park, Wash., covers 2.5 square miles (1961) and extends from an altitude of about 14,300 feet near the top of Mount Rainier down to 4,700 feet in a horizontal distance of 4.1 miles. Photographs illustrating the retreat and advance of the glacier's west ice margin in a reach extending for about a mile downstream from Wilson Glacier show that, by 1965, most of the ice thickness lost in that area between 1890 and 1944 had been recovered. Year-to-year variations in the surface slope and other characteristics from place to place along the glacier are portrayed by pictures to a degree not economically attainable by any other means. Medial moraines and other persistent patterns sometimes overlooked in the field are more noticeable in photographs. Ice-cored moraines and patterns of multiple lateral moraines are visible. Effects of the 1932 and 1955 outburst floods on the stream channel and trees for a mile or so below the glacier are shown. Some photographic procedures recommended for use in a program of this type are described. (Knapp-USGS)

W70-06143

7B. Data Acquisition

WATERSHED HYDRAULICS IN THE LABORATORY,

Missouri Univ., Rolla. Dept. of Civil Engineering. For primary bibliographic entry see Field 02E.

W70-05920

THE THERMOMETRICAL METHODS OF STUDYING GROUNDWATER,

All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).

For primary bibliographic entry see Field 02F.

W70-05938

A METHOD OF DETERMINATION OF THE INTENSITY OF A STREAM MACROTURBULENCE THROUGH APPLICATION OF A THERMISTOR,

Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.

E. Masiar.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B28, p 237-248, 1967, 12 p, 12 fig, 1 ref.

Descriptors: *Instrumentation, *Flowmeters, *Turbulence, *Vortices, Flow measurement, Turbulent flow, Thermometers, Heat transfer, Calibrations, Anemometers.

Identifiers: Macroturbulence measurement, Thermistors.

Turbulence measurements were made with a thermistor to evaluate the intensity of turbulence on the basis of the line of so-called 'instantaneous' velocities of a turbulent water stream or on the basis of the corresponding line of the time current course. The advantages of the new method are the speed and accuracy of measurements as well as the possibility of evaluating the intensity of macroturbulence at single points. (Knapp-USGS) W70-05950

THE STEADY STATE AND DYNAMIC HEAT TRANSFER FROM TURBULENCE SENSORS IN LIQUIDS,

Purdue Univ., Lafayette, Ind.; and Tennessee Technological Univ., Cookeville.

J. W. Delleur, G. H. Toebes, and C. L. Liu.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B27, p 227-236, 1967. 10 p, 6 fig, 2 tab, 7 ref.

Descriptors: *Model studies, *Hydraulic models, *Instrumentation, *Open channel flow, *Turbulent flow, Heat transfer, Thermometers, Flow measurement, Calibrations, Anemometers, Flowmeters. Identifiers: Turbulence measurement, Hot-wire anemometers.

The measurement of turbulence parameters in liquid flows is becoming increasingly important. The adequacy and potential of possible transducer systems are poorly known. Among the several possible systems two cylindrical sensors, the hot-wire and the cylindrical hot-film, are studied. Steady state heat transfers from Hytemco wire and from quartz-coated cylindrical-platinum film in water and in aqueous solutions of ethylene glycol were measured. Experiments were made in a rotating vessel which provided a flow field of controllable fluid velocity, temperature and composition. This heat transfer may be predicted with reasonable accuracy by Kramers' formula, which may also be used with confidence for analytical purposes, but is not intended to replace calibration procedures. The amplitude and phase frequency response of the anemometers were obtained by oscillating the sensors along the axis and in the potential core of a submerged water jet. The amplitude-frequency response was found to be nearly constant within the tested range of 2 to 38 cycles per second. The phase shift was found to be less than 10 deg on the average for frequencies between 10 and 38 cps and averaged approximately 20 deg below 10 cps. The equipment and the method of system evaluation are probably adequate for turbulence measurement in water, because most of the turbulence energy is found below 50 cps in usual hydraulic flow fields. (Knapp-USGS)

W70-05952

THEORETICAL ASPECTS OF THE COMPARABILITY OF PRODUCTIVITY DATA,

Freshwater Biological Association, Wareham (England). River Lab.

D. F. Westlake.

Proceedings of the International Biological Program Symposium on Primary Productivity in Aquatic Environments, Pallanza, Italy, April 1965. Memorie dell'Istituto Italiano di Idrobiologia, 18 Supplement, p 313-322, 1965. 9 ref.

Descriptors: *Classification, *Productivity, *Biomass, Bioassay, Energy, Primary productivity, Methodology, Biology, Theoretical analysis.

Identifiers: *Definitions, *Terminology, International Biological Program, Criteria.

In view of the aim of International Biological Program to obtain internationally comparable observations of basic biological parameters, standard terminology, criteria, units of measure, and methodology are proposed for investigations of primary production in aquatic ecosystems. Defined terminology includes biomass, primary production, primary productivity, gross and net productivity, standing crop, crop and yield. For productivity and biomass, the use of organic dry weight as the primary criterion is suggested. Measurements should be made by most accurate method available, then converted to the acceptable criterion. Use of sequences of conversion factors should be avoided. Preferred units of biomass are kilogram (kg) per square meter or grams per square meter; for productivity, grams per square meter per day or metric tons per hectare per year; for irradiance, gram-calories per square centimeter per minute or watts per square centimeter, per minute or watts per square centimeter. When energy-flow data are presented on a hectare-year basis, the standard nutritional unit 10 (to the sixth power kg cal) is suggested. A discussion of some problems involving methods and conversions is given, centering around measurements of biomass and productivity in typical two-layered aquatic systems. (Voigtlander-Wisconsin) W70-05978

THE SOLUBILITY OF OXYGEN IN WINKLER REAGENTS USED FOR THE DETERMINATION OF DISSOLVED OXYGEN,

Liverpool Univ. (England). Dept. of Oceanography.

C. N. Murray, J. P. Riley, and T. R. S. Wilson. Deep Sea Research, Vol 15, p 237-238, 1968. 9 ref.

Descriptors: *Oxygen, *Analytical techniques, *Solubility, *Dissolved oxygen, Sea water, Technology, Application methods, Chemical reactions, Physical properties, Methodology.

Identifiers: *Winkler reagents, *Determination, Errors.

Although the Winkler method has been used for oxygen determination in sea water over 75 years, little has been done to measure the error produced by dissolved oxygen introduced with the two reagents. While this error is negligible for routine purposes, which Carpenter estimated at 0.018 milliliters/liter, in precision work, such as measurement of oxygen solubility, it may considerably exceed the experimental error. Attempts to determine the solubility of oxygen in Winkler reagents by both physical and chemical methods is described. A modification of the procedure followed by Ben Naim and Baer was used for the physical measurements and the error estimated as 0.012 milliliters/liter. Failure to make this correction would produce a positive error of about 0.24% for sea water at 20C. The chemical determination of the amount of oxygen added with the Winkler reagents indicated that use of 1 milliliter of each Winkler reagent in a determination carried out in a 140 milliliter flask produces an error of 0.011 milliliters/liter, a figure in excellent agreement with that found physically. (Jones-Wisconsin) W70-05996

THE QUESTION OF MEASURING AVERAGE VELOCITY RATE IN PIPES BY MEANS OF POINT-TYPE SENSORS,

Foreign Technology Div., Wright AFB, Ohio.

For primary bibliographic entry see Field 08A.

W70-06031

PROVISIONAL TIME-OF-TRAVEL FOR ILLINOIS STREAMS,

Illinois State Water Survey, Urbana.

For primary bibliographic entry see Field 02E.

W70-06035

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

APPLICATION OF ELECTRIC WELL LOGGING AND OTHER WELL LOGGING METHODS IN HAWAII.
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02F.
W70-06098

SOME EXPERIMENTS WITH THE HOT-FILM ANEMOMETER IN WATER,
Queen's Univ., Belfast (North Ireland). Dept. of Civil Engineering.
R. H. J. Sellin.
Journal of Hydraulic Research, Vol 8, No 1, p 71-88, 1970. 18 p, 6 fig, 7 ref.

Descriptors: *Anemometers, *Flowmeters, *Turbulent flow, *Eddies, Vortices, Turbulence, Instrumentation, Currents (Water), Statistical methods, Calibrations.
Identifiers: Hot-film anemometer.

These experiments were made with a conical shaped hot-film probe used in conjunction with a constant temperature bridge. The probe was mounted at the end of a rotating arm installed in a tank of water. The water was set into a random turbulent motion by means of a reciprocating grid-like plunger driven vertically close to the base of the tank. A statistical analysis of calibration data is presented together with an assessment of the repeatability of r.m.s. measurements, based on standard deviations. The angle of inclination between the probe axis and the local mean flow direction was varied and is shown to have an effect on the turbulence measurements recorded. Finally the frequency spectra are obtained for this type of turbulence and shown to be closely similar to those obtained for isotropic turbulence. (Knapp-USGS)
W70-06104

METEOROLOGICAL SATELLITE VIEWS OF CLOUD GROWTH ASSOCIATED WITH THE DEVELOPMENT OF SECONDARY CYCLONES,
National Aeronautics and Space Administration, Greenbelt, Md., Goddard Space Flight Center.

William E. Shenk.
Report available for sale by Clearinghouse, Springfield, Va. - Price \$3.00. National Aeronautics and Space Administration Technical Note TN D-5680, April 1970. 24 p, 28 fig, 2 tab, 6 ref.

Descriptors: *Remote sensing, *Meteorology, *Satellites (Artificial), *Cyclones, Synoptic analysis, Climatology, Weather data, Solar radiation, Fronts (Atmospheric), Storm structure, Weather patterns.
Identifiers: Secondary cyclones, TIROS IV, Radiometry.

During March 1962 the cloud changes associated with the predevelopment and development periods of two secondary cyclones in the North Pacific Ocean were viewed on at least two successive days by the 8-12 micron 'window' channel of the TIROS IV meteorological satellite. Both secondary cyclones developed at the base of the occlusion. For the two cases, when the secondary circulations were first noticeable on the surface chart, the equivalent blackbody temperatures, T (BB), as measured by the radiometer averaged 15 deg K colder than the day before in the northeast quadrant relative to the base of the occlusion. The average T (BB) was taken over an area of approximately 300,000 square miles. For two other cases, an average warming of 4 deg K occurred from day to day over the same area relative to the base of the occlusion when no significant secondary development occurred and when the primary occluded cyclone was slowly weakening. These results suggest that, with the assistance of meteorological satellite radiation data, considerable cloud growth is noticeable prior to the generation of a secondary cyclone at the base of the occlusion. (Knapp-USGS)
W70-06127

PERCEPTION VIA SATELLITE,
Department of the Interior, Washington, D.C. Earth Resources Observation Satellite Program. Charles J. Robinove. Water Spectrum, Vol 2, No 1, p 14-19, Spring 1970. 6 p, 5 fig.

Descriptors: *Remote sensing, *Satellites (Artificial), Telemetry, Hydrologic data, Data collections, Surveys, Investigations, Aerial photography, Photogrammetry, Radar, Photography, Mapping. Identifiers: Hydrologic remote sensing.

The Earth Resources Observation Satellite (EROS) Program in the Department of the Interior is intended to gather and use data from satellites and aircraft on natural and man-made features of the earth's surface. Earth Resources Technology Satellite will provide the EROS Program with data for use in dealing with natural resource problems and understanding the interaction between man and the environment. Applications will include studies of tectonic features, hydrologic problems, location of fish schools, determination of the conditions of range land, mapping land use for urban planning, studies of erosion and change along coastlines and major streams, and inventories of land use and land forms. In addition, the ERTS data may be used for detecting forest and crop diseases and inventorying crops. The ERTS satellite will be in a polar, sun-synchronous orbit so that each point on the earth's surface will be sensed every 17 to 20 days, at the same time of day. Multispectral photography is being investigated for its usefulness in hydrology. Side-looking airborne radar has not yet been widely used in hydrologic studies, although it is an excellent tool for all-weather, day or night, coverage of large areas. Other techniques being investigated include passive microwave radiometry, ultraviolet and visible stimulated luminescence, and absorption spectroscopy. (Knapp-USGS)
W70-06136

INDIRECT SENSING OF ATMOSPHERIC WATER VAPOR,
Barney J. Conrath.

In: Significant Accomplishments in Science, National Aeronautics and Space Admin Special Publication NASA SP-195, Proceedings of Symposium, Goddard Space Flight Center, Jan 10, 1969, p 20-22. 3 p, 2 fig.

Descriptors: *Water vapor, *Remote sensing, *Meteoric water, *Methodology, *Analytical techniques, Extraterrestrial hydrology, Satellites (Artificial), Atmospheric physics, Infrared radiation, Absorption, Temperature, Humidity. Identifiers: *Atmospheric water vapor, Satellite-borne sensors, Nimbus B2.

Methods are briefly described of investigating water vapor from space using satellite-borne sensors to make in situ measurements. Analytical techniques are given for studying the vertical distribution of ozone and water vapor, gases which are optically active in the infrared. Basic principles are illustrated and results of an application to actual data obtained from infrared interferometer spectrometer sonde ascents are demonstrated. Infrared radiation intensity reaching a satellite-borne sensor in a narrow spectral band can be regarded as the weighted mean of the Planck intensities associated with the temperature at each level in the atmosphere. Computation methods are being developed, and data from Nimbus B2 satellite will allow testing the techniques on a global basis. (Lang-USGS)
W70-06159

OPTICAL METHOD FOR EXPERIMENTAL STUDIES ON TURBULENT FLOWS,
Vsesoyuznyi Nauchno Issledovatel'skii Institut Gidrotekhniki, Leningrad (USSR). M. W. Pechenkin.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in

hydraulics), Paper B26, p 218-226, 1967. 9 p, 4 fig, 1 tab, 3 ref.

Descriptors: *Model studies, *Hydraulic models, *Turbulent flow, Open channel flow, Closed conduit flow, Photography, Instrumentation. Identifiers: Optical measurement.

The techniques and instrumentation used in experimental studies of turbulent flows are discussed. Data are given on the experimental hydraulic apparatus, photographic equipment with flash tubes and the arrangement for picture treatment. The same techniques are extended to two-phase flows. For this purpose transparent materials with identical refractive indices are employed for both the supporting fluid and the suspended matter. (Knapp-USGS)
W70-06174

7C. Evaluation, Processing and Publication

COLOR OF WATER IN FLORIDA STREAMS AND CANALS,
Geological Survey, Tallahassee, Fla. Matthew I. Kaufman.

Florida Bureau Geology Map Series No 35, 1969. 1 sheet, Text, 7 fig, 1 map, 3 tab, 12 ref.

Descriptors: *Florida, *Water quality, *Regional analysis, *Color, *Decomposing organic matter, Organic acids, Swamps, Seasonal. Identifiers: Water color-discharge relations, Chemical associations.

A 1-sheet atlas report of the occurrence and distribution of color in Florida streams includes sources, nature and significance, regional distribution and chemical associations, seasonal variations, and the relations of color to streamflow. Many of Florida's surface waters are highly colored, ranging from less than 100 units to greater than 500 units (platinum-cobalt scale). Broad regions of considerable color (300 to over 500 units) include northeast and northcentral Florida, where streams drain extensive swamplands and southeast Florida in the environs of Lake Okeechobee where canals drain intensively cultivated agricultural lands. Most of the highly colored streams in Florida have low specific conductance, are soft, acidic, and contain appreciable iron. The color is derived from the natural decomposition of organic matter and is associated with carbon dioxide and organic acids. Maximum color values predominate during July through October, coincident with the period of active decomposition and leaching of organic matter and the flush-action of high rainfall and runoff. (Kaufman-USGS)
W70-05931

QUANTITATIVE INTERPRETATION OF REGIONAL GROUNDWATER FLOW PATTERNS AS AN AID TO WATER BALANCE STUDIES,
Department of Energy, Mines and Resources, Calgary (Alberta).

For primary bibliographic entry see Field 02F.
W70-05932

ANALYSIS OF THE GROUNDWATER HYDROGRAPH,
For primary bibliographic entry see Field 02F.
W70-05936

MODELLING OF INFILTRATION PROCESS IN THE ANALOG COMPUTER,
Gidrometeorologicheskii Institut, Odessa (USSR). For primary bibliographic entry see Field 2G.
W70-05941

RHEOELECTRIC ANALOGY; STUDY OF AN ARTESIAN BASIN, APPLICATION ON THE AR-

TESIAN GROUNDWATER OF THE 'SABLES INFÉRIEURS D'AQUITAINE' (IN FRENCH),
Bordeaux Univ. (France). Dept. of Hydrogeology.
For primary bibliographic entry see Field 02F.
W70-05945

ON THE TECHNIQUE FOR SOLVING
HYDROGEOLOGICAL PROBLEMS USING
SOLID AND NETWORK ELECTRIC MODELS,
All-Union Scientific Research Inst. of Hydrogeology
and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 02F.
W70-05946

A THREE PARAMETER DISTRIBUTION FOR
PRECIPITATION DATA WITH A STRAIGHT-
LINE PLOTTING METHOD,
Nevada Univ., Reno. Center for Water Resources
Research.
For primary bibliographic entry see Field 02B.
W70-05961

LONGITUDINAL DISPERSION OF THE
LOWER KANSAS RIVER BASIN,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02E.
W70-06096

A MULTIPLE REGRESSION TECHNIQUE FOR
ADJUSTING BACKGROUND VALUES IN
STREAM SEDIMENT GEOCHEMISTRY,
Pennsylvania State Univ., University Park. Mineral
Conservation Section; and Pennsylvania State
Univ., University Park. Dept. of Geochemistry and
Mineralogy.
For primary bibliographic entry see Field 02K.
W70-06124

AN INVENTORY OF LARGE LAKES IN
CALIFORNIA,
Geological Survey, Menlo Park, Calif. Water
Resources Div.
For primary bibliographic entry see Field 02H.
W70-06149

EVALUATION OF A DIGITAL COMPUTER
METHOD FOR ANALYSIS OF COMPARTMENTAL
MODELS OF ECOLOGICAL SYSTEMS,
Colorado State Univ., Fort Collins. Coll. of
Forestry and Natural Resources.
L. J. Bledsoe, and G. M. Van Dyne.
Oak Ridge National Laboratory, Tennessee. Health
Physics Division, Radiation Ecology Section,
ORNL-TM-2414, February 1969. 64 p. 7 fig, 7 tab,
8 ref, append A, B, C, D.

Descriptors: *Analytical techniques, *Digital computers, *Ecosystems, *Systems analysis, Computer models, Computer programs, Data processing, Leaching, Energy transfer, Mass transfer, Mathematical models, Simulation analysis, Planning, Stochastic processes, Statistical methods, Soil dynamics, Radioecology, Tracers, Radioactivity. Identifiers: *Compartmental models, COMSYS2, FORTRAN IV, FORTRAN 63, CDC 6400, CDC 1604, IBM 360/75, IBM 7090, Differential equations, Forest litter, Statistical variability, Millipedes, Theoretical ecology, COMSYS2 (MOD 1), COMSYS2 (MOD 2), COMSYS1, Microcosms.

COMSYS2, a digital computer program, was developed for data analysis from studies in which ecosystems are represented by compartmental models wherein energy or matter flows between compartments. If flow between compartments is depicted by a set of linear, homogeneous differential equations, COMSYS2--accepting empirical data on contents of some or all compartments at a series of points in time--generates a matrix of coefficients for equations describing possible transfers within the ecosystem. COMSYS2 has been written in FORTRAN 63 for CDC 6400 and 1604

computers, and in FORTRAN IV for IBM 360/75 and 7090 systems. Real and synthetic data were used to test for type and convergence rate toward minimized sum of squared deviations between observed and predicted data points for each compartment. Synthetic data were generated with known degrees and types of errors so as to simulate variability normally encountered in biological systems. Results of computer simulations are tabulated and presented graphically, and listings of programs and subroutines, with directions for use, are appended. Generally, COMSYS2 performs well, but--with highly variable data--may not converge on true parameters practicable soon, and care must be exercised in selecting reasonably realistic initial values required by the program. (Eichhorn-Wisconsin)
W70-06231

THE MODIFICATION OF A PREDICTIVE
RIVER BASIN MODEL,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 05G.
W70-06313

08. ENGINEERING WORKS

8A. Structures

INVESTIGATIONS OF VARIOUS SHAPES OF
THE UPSTREAM QUADRANT OF THE CREST
OF A HIGH SPILLWAY,
Army Engineer Waterways Experiment Station,
Vicksburg, Miss. Hydraulics Div.
E. S. Melsheimer, and T. E. Murphy.
Corps of Engineers Research Report H-70-1,
January 1970. 4 p, 16 plate.

Descriptors: *Open channel flow, *Spillway crests, *Hydraulics, Cavitation, Discharge (Water), Abutments, Spillways, Hydraulic structures, Aeration. Identifiers: Spillway flow.

The effects shape of the upstream quadrant of the crest of a high spillway on water flow was studied. Tests involved determination of pressures and discharge coefficients, with and without crest piers, at heads varying from one-fourth the design head to one and one-half times the design head. Limiting conditions for cavitation on the crest are defined. For all crests the pressures at the crest line were essentially the same for equal discharges. The variations in minimum pressures occurred in dips in the pressure gradients on the upstream quadrant and thus apparently had no effect on the discharge coefficients. Pier contraction coefficients are sensitive to direction of approach flow, width of pier, and position of pier nose with respect to crest as well as pier-nose shape; thus it is hard to develop generalized data applicable to any particular set of conditions. Usually, structural considerations will result in crest piers sufficiently long to extend downstream of the subatmospheric pressure zone on the spillway crest; however, care should be taken to see that this always is true. If the downstream end of the pier is located within the subatmospheric zone, aeration of the spillway nappe is a possibility. This could result in a loss of capacity or, worse still, in an unstable nappe. (Knapp-USGS)
W70-05915

THE STRENGTH AND CREEP OF FROZEN
SOILS AND CALCULATIONS FOR ICE-SOIL
RETAINING STRUCTURES,
Cold Regions Research and Engineering Lab.,
Hanover, N.H.
For primary bibliographic entry see Field 08D.
W70-05968

THE QUESTION OF MEASURING AVERAGE
VELOCITY RATE IN PIPES BY MEANS OF
POINT-TYPE SENSORS,
Foreign Technology Div., Wright AFB, Ohio.

V. M. Kos, and Yu I. Sitniskiy.

Trans. of Kontrolno-Izemeritel'naya Tekhnika (USSR) No. 4, p. 123-126, 1968. Available from the Clearinghouse as AD-700 368, \$3.00 in paper copy, \$0.65 in microfiche. Translation No. FTD-23-2420-69, Sept. 18, 1969, 9 p. 3 refs.

Descriptors: *Flow rates, *Turbulent flow, *Pipe flow, Pipes, Average flow, *Flow measurement.

Assuming that the rates of flow are symmetrically distributed with respect to the pipe axis, the location of a layer is found in which the flow rate is equal to the average flow rate of the fluid in the pipe; the variation of this location with the varying average rate is investigated. Experimental curves of rate versus radius are shown. These curves are described by an exponential equation. Examination of this equation shows that the measurement of the average rate by a point-type sensor placed in the average-rate layer is much more accurate than the measurement of the maximum rate with subsequent rate correction. The theoretical error of measurement when the point sensor is displaced from its true average-layer position by 1 percent is 0.15 percent. However, the practical value of this error will be somewhat higher.
W70-06031

OCEAN ENVIRONMENT AND DESIGN CONSIDERATIONS IN A PRERECONNAISSANCE STUDY OF A CALIFORNIA UNDERSEA AQUEDUCT,
Litton Systems, Inc., El Segundo, Calif. Advanced Marine Technology Div.
Fred C. Lee.

For the Bureau of Reclamation. Available from the Clearinghouse as PB-189 110, \$3.00 in paper copy, \$0.65 in microfiche. Report, 30 Jun 69, 94 p.

Descriptors: Water resources development, Marine geology, Aqueducts, Water supply, Pipelines, Continental shelf.

A planning study for the design of an undersea aqueduct system which will have an incremental capacity in the range of 2,000,000 to 3,500,000 acre-feet of water per year. Design parameters include: Pipe design considerations; (Pipe configurations and materials, status of data acquisition, design of filament-wound pipe, sections and joints, anchoring concepts, materials testing), Construction and operation and maintenance procedures; (Pipe manufacturing, design of marine system for installation and operation and maintenance), Surveys of the ocean environment; (Parameters of motion, bathymetry, geology/soil mechanics, fouling studies); Materials, selection and testing; Primary definition of optimal construction and operation and maintenance configuration; Preliminary program cost estimate for reconnaissance study.
W70-06032

OBJECTIVE DETERMINATION OF SAFETY FACTOR IN RESERVOIR DESIGN,
Geological Survey, Washington, D.C.; Geological Survey, Fort Collins, Colo.; and Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

Edward R. Close, Leo R. Beard, and David R. Dawdy.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7297, p 1167-1177, May 1970. 11 p, 12 fig, 2 tab, 3 ref.

Descriptors: *Reservoir design, *Cost-benefit analysis, *Optimization, *Simulation analysis, *Safety factors, Statistical models, Systems analysis, Hydrology, Probability, Sampling, Streamflow forecasting, Economics, Project planning, Water resources development, Design criteria. Identifiers: Hydrologic safety factor.

Objective criteria for determining hydrologic safety factor for reservoir design are developed for streamflow sample sizes of 10 yr, 25 yr and 100 yr. For the smaller sample sizes, the index of allowable shortages, for which average net benefits are max-

Field 08—ENGINEERING WORKS

Group 8A—Structures

imum, is also smaller. This reduction in the index of allowable shortages results in an increase in the average reservoir size needed to offset the effects of sampling error. Thus, by varying the index of allowable shortages on the basis of hydrologic record length, safety factors may be determined. (Knapp-USGS)
W70-06111

PREVENTION OF SCOUR AT BRIDGE ABUTMENTS,

Texas A and M Univ., College Station. Dept. of Civil Engineering.

John B. Herbich.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macro-turbulence and stochastic processes in hydraulics), Paper B9, p 74-87, 1967. 14 p, 11 fig, 19 ref.

Descriptors: *Scour, *Alluvial channels, *Bridges, Stream erosion, Erosion control, Bed load, Sediment transport, Floods, Model studies, Hydraulic models, Hydraulics.

Identifiers: Bridge abutments.

Many highway and railroad bridges fail during floods. The failure in many instances is attributed to local scour of river bed and subsequent failure of abutments. Spur dikes extending upstream from the abutments, in providing a smooth transition for the flow, were found to be extremely effective in reducing scour at the abutments. Studies which were conducted on both the fixed-bed and movable-bed model included variations in the percentages in waterway opening, dike angle with abutment and dike shape to a minor extent. The percentage waterway openings were selected to provide overlapping of scour patterns from each abutment. Two bridge crossings were considered; at 90-deg and at 60-deg to the direction of flow. (Knapp-USGS)
W70-06166

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, SUMMARY REPORT.

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06185

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME I - TEXT.

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06186

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME II - TECHNICAL APPENDICES.

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06187

PLANNING PROGRAM (1969).

Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06B.
W70-06188

EVALUATION OF REINFORCED PLASTIC MORTAR PIPE FOR WATER RESOURCES APPLICATIONS--A PROGRESS REPORT,

Bureau of Reclamation, Denver, Colo.
L. O. Timblin, Jr., and C. E. Selander.
Paper, Amer. Soc. Civ. Eng. Irrig. Drain Div. Conf., Austin, Tex., Nov. 1969. 37 p, 17 fig, 6 ref.

Descriptors: *Water pipes, Water supply systems, *Sewers, *Pipelines, Pipes, Composite materials, Sands, Glass fibers, *Plastic pipes, Field tests, Filaments, Laboratory tests, Research and development.

Physical properties, Mechanical properties, Deformation, *Pressure pipes, Creep, Stiffness, Durability, Scaling, Fatigue (Mechanics), Environmental tests.
Identifiers: *Reinforced plastic mortar pipe, *Pipe tests, Polyesters, Glass reinforced plastics, Filament-wound construction, Pipe joints.

Reinforced Plastic Mortar (RPM) pipe was developed as a high-quality pipe to compete as an alternate to conventional water pipes such as cement asbestos, concrete, and steel. A Government-industry cooperative study of RPM pipe was initiated with the objective of generating sufficient performance data and knowledge to permit preparation of Bureau of Reclamation specifications for obtaining reliable pipe. Laboratory tests were designed to: (1) evaluate changes in physical properties after environmental exposure, (2) determine if performance of large-diameter pipe can be correlated to performance of small-diameter pipe by scaling factors, and (3) relate stiffness data for various classes of RPM pipe. Tests were also made to determine deformation of RPM pipe buried in compacted soil and under external load. Field studies included tests on a 15-in.-dia pipe in a test section in the Westlands Irrigation District, Calif, and a 39-in.-dia pipe in the Lower Yellowstone Irrigation District, Mont. Results to date show that performance is as expected, and if present trends continue, RPM pipe eventually may be specified as an alternate to other types of water pipe. (USBR)
W70-06246

RIVER DIVERSION AND CLOSURE,

International Power and Engineering Consultants Ltd., Vancouver (British Columbia).

I. C. Dirom.

Engineering Journal, Canada, Vol. 52, No. 10, p. 57-60, Oct. 1969. 4 p, 6 fig, 1 ref.

Descriptors: *Diversion, Diversion structures, Diversion works, Tunnel construction, *Diversion tunnels, Tunnel design, Tunneling, *Scheduling, Tunnel linings, *River closures, Flow control, Performance, Stop logs, Outlet works, Foreign construction.

Identifiers: Closures, Tunnel inverts, Outlet tunnels, *W A C Bennett Dam (Canada), Construction methods, Stage construction.

Diversion facilities for W A C Bennett Dam consisted of a 140-ft-high cofferdam and three 48-ft horse shoe-shaped, concrete-lined tunnels, each approximately one-half mile long, located in the right abutment. The tunnels were designed to pass a flood flow of 270,000 cfs, having an estimated 15-yr frequency. Because of large ice flows and floating debris, the tunnels were designed for free flow up to the peak discharge. A reduction in the tunnel cross-sectional area was achieved by steepening the tunnel invert at the entrance to accelerate the flow. The tunnels operated successfully, passing ice, debris, and a record flood flow of 311,000 cfs without flowing full. Complex scheduling and a stage construction program for converting the tunnels to low level outlets while still required for diversion are described. (USBR)
W70-06248

PENSTOCK STEEL LINER--DESIGN AGAINST EXTERNAL PRESSURE,

International Power and Engineering Consultants Ltd., Vancouver (British Columbia).

H. Lauga.

Engineering Journal Canada, Vol 52, No 10, p 43-46, Oct 1969. 4 p, 2 graph, 2 tab, 4 ref.

Descriptors: *Penstocks, *Steel linings, External forces, Design, *Buckling, Hydrostatic pressure, Steel pipes, Graphical analysis, Safety factors, Deformation, Bracings, Pressure tunnels, Theory, Foreign design practices, Grouting, Pressure conduits, Pressure pipes.

Identifiers: Portage Mountain Powerplant (Canada), Grouting pressure, Comparative studies, Pressure shafts.

A method for determining the critical buckling pressure for circular steel linings in underground shafts subject to external pressure is presented. The method, used in designing the penstocks for Portage Mountain Powerplant, Canada, was developed because of inconsistencies in available methods and to establish means for taking into account fabrication and construction tolerances. For many given sets of conditions, the critical buckling pressure, or a fairly narrow range of possible critical buckling pressures, can be determined with reasonable accuracy. The method will be a useful tool for determining appropriate pressures for contact grouting. Construction of a graph used to determine the effect of out-of-roundness for the Portage Mountain penstocks is described. Theories of critical buckling of steel pipes in a confined space developed by Amstutz, Borot, and Vaughan are discussed. (USBR)
W70-06249

W A C BENNETT DAM,

International Power and Engineering Consultants Ltd., Vancouver (British Columbia).

For primary bibliographic entry see Field 08D.

W70-06250

THE USE OF MODEL TESTS IN THE DETERMINATION OF THE SAFETY FACTOR IN ARCH DAMS,

Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).

Manuel Rocha, A. F. da Silveira, and Maria Cruz Azevedo.

Water Power, Vol 21, No 12, p 461-465, Dec 1969. 5 p, 10 fig, 2 tab, 4 ref.

Descriptors: Concrete dams, *Arch dams, Dam design, Dams, Compressive strength, Model studies, *Model tests, *Safety factors, Design criteria, Plastic deformation, Stress, Strain, Foreign research.

Identifiers: Concrete properties, Allowable stress, Similitude, Design practices, Compressive stress, Foreign testing, Portugal.

Concepts of safety in concrete arch dams are discussed and model tests to determine safety factors with respect to concrete strength are described. Numerous studies on dams having different characteristics disclose extremely high safety factors with respect to concrete strength, and show the marked influence of concrete plasticification on these values. Design values for allowable compressive stress in concrete arch dams can be increased substantially without changing typical concrete strengths. Similitude requirements between the models and prototypes are discussed. (USBR)
W70-06254

CONSTRUCTION SAFETY--THE CHALLENGE OF THE '70'S,

Bureau of Reclamation, Denver, Colo.

Howard S. Latham.

Paper, Reg Safety Constr Eng Conf, Boise, Idaho, Jan 1970. 18 p.

Descriptors: *Construction, *Safety, Accidents, Training, Future planning (Projected), Tangible benefits, Insurance costs, Legislation, Health, Codes, Education, Standards, Failures, Statistics, Instruction, Responsibilities.

Identifiers: Injuries, Bureau of Reclamation, Enforcement, Health protection.

The construction industry has one of the highest injury rates, claiming an average of 2,600 lives and 250,000 disabling injuries per year. The principal cause of construction accidents has been inability to cope fully with the human element. A 4-yr study of accident causes throughout the Department of the Interior shows that 86% of all accidents involving use of construction equipment resulted from personal causes. The basic fault lies with the failure of management and labor to provide effective safety education and training. Experience shows that the Safety Training Course for Construction

Supervisors sponsored by the Associated General Contractors of America is an effective program. Because of the length and expense of the program, it is reaching only a few hundred people a year, when to be truly effective it should be reaching thousands. A program (based on the AGC course) planned by the Bureau of Reclamation with the aim of being made available to all contractor foremen on Bureau jobs is outlined. Safety records of Bureau of Reclamation contractors, safety records of the construction industry, and legislation aimed at improving construction safety are discussed. (USBR)

W70-06257

8B. Hydraulics

PATTERN OF POTENTIAL FLOW IN A FREE OVERFALL,

California Univ., Davis. Dept. of Water Science and Engineering; and Pahlavi Univ., Shiraz (Iran). Dept. of Engineering.

Theodor Streikoff, and Mohammad S. Moayeri. ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7207, p 879-901, April 1970. 23 p, 12 fig, 15 ref, append. OWRR Project B-037-CAL.

Descriptors: *Open channel flow, *Overfalls, Hydraulic structures, Hydraulics, Obstruction to flow, Mathematical studies, Jets.

Identifiers: Free overfalls.

A theory is presented to describe the two-dimensional flow of liquid in an open channel which terminates abruptly at a sharp drop. A dimensionless diagram expressing constancy of total head on the upper free surface is similar to the conventional specific-head versus depth and discharge versus depth diagrams. It is used to trace the course of the flow in the overfall. The ratio of free-surface-velocity magnitude to average horizontal component of velocity in the cross section is a decreasing function of distance in the direction of flow. The limiting case of the free overfall is at a Froude number approaching unity. A detailed description of the flow is given by an integral equation derived from conformal mapping and singularity distributions. Comparisons are made between the computed profiles and theoretical and experimental results of other investigators. (Knapp-USGS)

W70-05909

BRIDGE BACKWATER IN WIDE VALLEYS,

Arizona Univ., Tucson. Dept. of Civil Engineering; and Bureau of Public Roads, Washington, D.C.

Emmett M. Laursen.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7246, p 1019-1038, April 1970. 20 p, 12 fig, 3 tab, 9 ref, append.

Descriptors: *Floods, *Bridges, *Backwater, Flow profiles, Flood plains, Obstruction to flow, Streamflow.

Identifiers: Bridge backwater.

A method is presented for calculating the longitudinal water surface profile in the reach of a river in flood which is disturbed by the presence of the bridge and embankment fill. A variety of profiles is found to be possible depending on the abstraction or accretion rates and the resistance to flow. Because the flow on the floodplain is concentrated by the valley crossing, backwater is possible downstream from the bridge as well as upstream. (Knapp-USGS)

W70-05912

INVESTIGATIONS OF VARIOUS SHAPES OF THE UPSTREAM QUADRANT OF THE CREST OF A HIGH SPILLWAY,

Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Div.

For primary bibliographic entry see Field 08A.

W70-05915

RESULTS OF THE STUDY OF MACROTURBULENT MOVEMENT DOWNSTREAM OF A HYDRAULIC JUMP (IN FRENCH),

Institute of Hydrotechnical Research, Bucharest (Romania). Hydraulics Section.

E. Razvan.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B4, p 26-35, 1967. 10 p, 8 fig, 8 ref.

Descriptors: *Turbulent flow, *Vortices, *Mathematical studies, Hydraulic jump, Stilling basins, Erosion, Scour, Alluvial channels, Open channel flow, Hydraulic models, Model studies.

Identifiers: *Macroturbulence.

Extinction of macropulsations and a constructive solution for the diminishment of the necessary length of bed protection downstream of dams are discussed. The theoretical extinction length is obviously higher than that resulting from empirical relations; level oscillations generated by hydraulic jump are significant. To reduce the macropulsation extinction length, the construction of a baffled apron downstream from the stilling basin is recommended. A reduction of 40 percent is possible, provided all other conditions should be the same. The proposed structure is in satisfactory use at various dams in Rumania. (Knapp-USGS)

W70-05947

MACROTURBULENCE OF A BOTTOM HYDRAULIC JUMP AND ITS INFLUENCE ON THE STABILITY OF THE BED OF THE LOWER TAILWATER,

Nauchno-Issledovatel'skii Gidroenergeticheskii Instituti, Tiflis (USSR).

T. G. Voinitch-Sianozhentskij, V. G. Lomtatidze, and G. N. Gvazava.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B15, p 128-134, 1967. 7 p, 4 fig, 3 ref.

Descriptors: *Turbulent flow, *Vortices, *Drops (Structures), *Hydraulic jump, Open channel flow, Eddies, Alluvial channels, Scour, Stream erosion, Mathematical studies.

Identifiers: Macroturbulence.

Hydraulic jump is correlated with the amplitude of macropulsion of the hydraulic pressure and the kinetic energy of the pulsation movement. Stability of the lower tail-water attachment is studied using a dynamic theory of stability. Suggestions are given for calculating the necessary amount of bed protection downstream of hydraulic jumps. (Knapp-USGS)

W70-05949

DYNAMIC CHARACTERISTICS OF THE FORCES ACTING ON THE SPILLWAY CHUTE,

Central Research Inst. of Electric Power Industry, Tokyo (Japan). Technical Lab.

Chiuchi Aki.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B19, p 163-170, 1967. 8 p, 5 fig, 3 tab, 7 ref.

Descriptors: *Turbulent flow, *Spillways, *Hydraulics, Turbulence, Closed conduits, Vortices, Hydrodynamics, Mathematical studies, Model studies, Hydraulic models.

Identifiers: *Aerodynamics (Hydraulic applications).

In connection with the construction of the pumped-storage power station of large capacity with the power house under the spillway chute, the dynamic characteristics of the forces acting on the chute

during flood discharge were studied. The mean values of dynamic forces acting on the chute and the characteristics of their fluctuations depend on the characteristics of the turbulent boundary layer developing along the spillway chute. In order to analyze these forces, measurements were made of velocity distributions and pressure fluctuations on spillway chutes in the field and the laboratory. A relation developed in aerodynamics, applicable to the intensity, the spatial scale, and the frequency characteristics of pressure fluctuations in turbulent boundary layers was also applicable to the high velocity flow of water on spillway chutes. (Knapp-USGS)

W70-05953

THE EFFECT OF BEND ON THE DISTRIBUTION AND DEVELOPMENT OF THE MACROTURBULENCE INTENSITY IN OPEN CHANNEL BEDS,

Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.

E. Masiar.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B18, p 154-162, 1967. 9 p, 3 fig, 5 ref.

Descriptors: *Turbulence, *Turbulent flow, *Meanders, *Alluvial channels, Open channel flow, Vortices, Model studies, Mathematical studies, Reynolds number.

Identifiers: *Macroturbulence.

In view of the fact that intensive channel-bed forming processes develop mostly in or near bends of open channels, the local turbulence intensity was studied to obtain a basis for determination of the relations between these two phenomena. The mean cross-section value of the macroturbulence intensity at the beginning of the bend first increases and having reached a maximum, decreases. This decrease sometimes reaches smaller values than in a direct section in front of the bend. All parameters influencing the value and distribution of mean longitudinal velocities also have an effect on the value and distribution of turbulence intensity in single cross-sections of the channel. (Knapp-USGS)

W70-05954

WAVE FORCES ON PILES: A DIFFRACTION THEORY,

Corps of Engineers, Washington, D.C. Beach Erosion Board.

For primary bibliographic entry see Field 02L.

W70-05967

COMPUTATIONAL STUDY OF ACCELERATED FLOW IN A TWO-DIMENSIONAL CONDUIT EXPANSION,

Iowa Univ., Iowa City. Inst. of Hydraulic Research; and Carnegie-Mellon Univ., Pittsburgh, Pa. Biotechnology Program.

Enzo O. Macagno, and Tin-Kan Hung.

Journal of Hydraulic Research, Vol 8, No 1, p 41-64, 1970. 24 p, 6 fig, 13 ref.

Descriptors: *Open channel flow, *Turbulent flow, *Vortices, *Flow around objects, Hydraulics, Turbulence, Model studies, Hydraulic models, Fluid mechanics, Flow separation, Hydrodynamics, Viscosity.

Identifiers: Flow expansion, Accelerated flow, Vorticity.

The accelerated flow of a viscous fluid due to a suddenly established discharge in a two-dimensional conduit expansion has been determined by numerical integration of the governing differential equations. The complete form of the equation for diffusion and convection of vorticity was employed. The Reynolds number of the flow, based on the prescribed discharge, was 200. The growth of the separation zones, assuming symmetric flow, was

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determined. Flow and vorticity patterns were calculated at short intervals of time; a selection of those patterns is presented, as well as curves showing the variation with time of the principal kinematic characteristics of the unsteady flow through the expansion. (Knapp-USGS)
W70-06105

SHIFTS OF SEDIMENT CONCENTRATION IN A VERTICAL PIPE.
Aberdeen Univ. (Scotland). Dept. of Engineering.
For primary bibliographic entry see Field 02J.
W70-06106

RESISTANCE STUDIES ON SMOOTH OPEN CHANNELS,
Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.

V. V. Jayaraman.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7266, p 1129-1142, May 1970. 14p, 10 fig, 2 tab, 9 ref, append.

Descriptors: *Open channel flow, *Hydraulic models, *Chezy equation, *Darcy-Weisbach equation, Correlation analysis, Steady flow, Uniform flow, Hydraulic similitude, Closed conduit flow, Hydraulics, Hydraulic radius, Fluid friction.
Identifiers: Hydraulic resistance.

Experiments were conducted on smooth open channels of different shapes to study the propriety of treating a channel as an equivalent pipe, the use of hydraulic mean radius and the application of pipe resistance laws to channels. The findings indicate that smooth pipe laws cannot be applied to smooth channels without reservations. A new approach has been suggested. The method takes into account the force causing motion, the geometrical parameters of the channel, and fluid properties. It is shown that it is possible to obtain mean velocity values without any need to determine the Darcy-Weisbach friction factor (f), or the mean shear stress along the boundary. (Knapp-USGS)
W70-06109

WORK-ENERGY EQUATION FOR THE STREAMLINE,
Iowa Univ., Iowa City. Coll. of Engineering.
For primary bibliographic entry see Field 02E.
W70-06112

STATISTICAL CHARACTERISTICS OF PRESSURE FLUCTUATIONS IN THE REGION OF HYDRAULIC JUMP,
Akademika Nauk SSSR.

O. F. Vasiliev, and V. I. Bukreyev.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B1, p 1-8, 1967. 8 p, 8 fig, 6 ref.

Descriptors: *Hydraulic jump, *Pressure, *Statistical methods, Turbulence, Open channel flow, Critical flow, Time series analysis, Correlation analysis, Turbulent flow.
Identifiers: Kinematic flow analysis.

The statistical characteristics that have been experimentally obtained of the low frequency part of the pressure fluctuations spectrum on the rigid bottom of a turbulent flow in the region of a hydraulic jump include space-time double correlations, auto-correlations, spectra, one-dimensional frequency distribution, RMS values, skewness and flatness coefficients. The methods used in the investigation are described and an analysis is made of the kinematical structure of the flow. An example is given of numerical calculations of the average load on the apron. (Knapp-USGS)
W70-06167

MACROTURBULENCE PRODUCED BY VORTEX BREAKDOWN IN HIGH VELOCITY FLOWS,
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Ingenieria.

Enzo Levi.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B7, p 54-60, 1967. 7 p, 7 fig, 4 ref.

Descriptors: *Turbulence, *Vortices, *Aeration, *Open channel flow, *Spillways, Hydraulic jump, Chutes, Drops (Structures), Overflow, Stilling basins, Weirs, Model studies, Hydraulic models.
Identifiers: *Macroturbulence, Longitudinal vortices.

Currents down steep chutes or spillways are normally streaked by longitudinal vortices embedded in them. Under favorable conditions, those vortices may break down and eventually mix up great quantities of atmospheric air. Some observations of the breakdown are described. It is explained how many macroturbulent effects usually ascribed to the boundary layer development may be imputed to breakdown. Finally an experiment which suggests an explanation of the inception of longitudinal vortices is described. (Knapp-USGS)
W70-06168

MACROTURBULENCE OF FLOWS BELOW SPILLWAYS OF MEDIUM HEAD DAMS AND THEIR PROTECTION AGAINST UNDERMINING,

Vsesoyuznyi Nauchno Issledovatel'skii Institut Gidrotehniki, Leningrad (USSR).
F. G. Gunko.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B16, p 135-143, 1967. 9 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Spillways, *Turbulence, *Scour, Vortices, Turbulent flow, Stilling basins, Drops (Structures), Hydraulics, Erosion, Energy dissipation.

Identifiers: *Macroturbulence.

Basic results of extensive studies by scientists on investigating operating conditions and energy dissipators below medium head spillways with large specific discharges are summarized. The experiments resulted in establishing the mechanism of flow action upon erodible coarse material by vortices in the area of intensive dissipation of excessive energy of the overflowing jet. These vortices cause an increase in velocity and pressure pulsation in the area under study. Investigations also showed that the intensity of action of highly turbulent flow on the erodible river bed can be characterized by sizes of gravel or stone lying on the bottom in the limit equilibrium state. Relationships were determined to relate water depths on the spillway apron, necessary stone sizes and the length of the rockfill pavement below the concrete slab of the spillway apron. (Knapp-USGS)
W70-06169

THE EFFECT OF MACROTURBULENCE IN THE TAILWATER OF TUBULAR SPILLWAYS ON TAILWATER STRUCTURES AND LOCAL SCOURING,

Kuibishev Civil Engineering Inst., Moscow (USSR).
N. P. Rozanov, L. S. Givotovsky, and N. N. Pashkov.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B17, p 144-153, 1967. 10 p, 6 fig, 10 ref.

Descriptors: *Scour, *Spillways, *Turbulence, Vortices, Turbulent flow, Stilling basins, Drops (Structures), Hydraulics, Erosion, Energy dissipation, Model studies, Hydraulic models.
Identifiers: *Macroturbulence.

Results are given of laboratory investigations of the effect of macroturbulence in the tailwater of tubular-type spillways on the tailwater structure and local scourings. Several layouts of tubular spillways were considered (single- and two-pipe with baffles and baffle piers) with stream impingement, ensuring sufficiently uniform distribution of specific discharge in the outlet channel. Values are tabulated of the pulsation coefficient for the hydrodynamic loads acting on the baffle piers and baffles under different conditions, the dependences to be used for determining the necessary thickness of fastening plates for a two pipe regulator, and charts of actual tailwater bottom velocities which are required for predicting scour. Scour is shown to be mainly determined by the bottom actual velocities. An approximated method for forecasting the depth of scoured holes is proposed. (Knapp-USGS)
W70-06170

PROBLEMS OF STABILITY OF STREAMS IN ERODED BEDS AND STABILITY OF THEIR SHAPES,

Nauchno-Issledovatel'skii Gidroenergeticheskii Institut, Tiflis (USSR).
For primary bibliographic entry see Field 02J.

W70-06171

THE MEASUREMENT OF TURBULENT VELOCITY FLUCTUATIONS CLOSE TO A BOUNDARY IN OPEN CHANNEL FLOW,
University Coll., London (England). Dept. of Civil Engineering.

Patrick Hubert Kemp, and Anthony James Grass.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B24, p 201-209, 1967. 9 p, 5 fig, 7 ref.

Descriptors: *Sediment transport, *Turbulent flow, Open channel flow, Model studies, Hydraulic models, Tracking techniques, Turbulent boundary layers, Boundary layers.

Identifiers: Hydrogen bubble tracers.

Research in the field of hydraulic sediment transport has suffered limitation in the past primarily due to lack of adequate instrumentation for measuring the characteristics of the flow in the immediate vicinity of the grains. The paper describes a refined method of measuring the turbulent velocity field in the boundary layer of open channel flow, using the hydrogen bubble method. Results are presented which show that a higher degree of precision is achieved than comparable measurements made by previous investigators in air. Both smooth and rough boundaries have been studied. For comparison with previously published data, the presentation is restricted to the smooth boundary case. (Knapp-USGS)
W70-06172

ANALYSIS OF RANDOM PRESSURE FLUCTUATIONS IN STILLING BASINS,
Bureau of Reclamation, Denver, Colo. Div. of Research.

D. L. King.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B25, p 210-217, 1967. 8 p, 5 fig.

Descriptors: *Turbulence, *Stilling basins, *Model studies, Hydraulic models, Vortices, Instrumentation, Statistical methods, Hydraulic jump, Drops (Structures), Hydraulics.
Identifiers: *Pressure fluctuation measurement, Macroturbulence.

Knowledge of the amplitude-frequency spectrum of pressure fluctuations caused by turbulence in hydraulic structures allows the determination of dynamic loading in structural design. Recent experience with prototype structures has indicated fatigue failure caused by vibration. Pilot studies were made for electronic analysis of random pressure fluctuations in models of two distinct types of energy dissipators. The studies were restricted to determination of dynamic loads acting on the structures, without regard to the dynamic response of the structures. The results are discussed with respect to their application to design problems and possible sources of error are described. (Knapp-USGS)

W70-06173

OPTICAL METHOD FOR EXPERIMENTAL STUDIES ON TURBULENT FLOWS,

Vsesoyuzny Nauchno Issledovatelskii Institut Gidrotehniki, Leningrad (USSR).

For primary bibliographic entry see Field 07B.

W70-06174

STOCHASTIC ANALYSIS OF THE AUTO-FORMATION OF A CHANNEL CUT IN INCOHERENT ALLUVIUM,

Institute for Water Resources, Belgrade (Yugoslavia). Dept. of River Research.

For primary bibliographic entry see Field 02J.

W70-06175

SCATTERING OF SURFACE WAVES BY RECTANGULAR OBSTACLES IN WATERS OF FINITE DEPTH,

Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.

Chiang C. Mei, and Jared L. Black.

Available from the Clearinghouse as AD-700 897, \$3.00 in paper copy, \$0.65 in microfiche. Journal of Fluid Mechanics, Vol 38, Part 3, p 499-511, 1969, 21 refs, 7 figs. Contract Nonr-1841 (59).

Descriptors: Waves (Water), *Ocean waves, *Barriers, *Docks, *Piers, Bulkheads, Numerical analysis.

Identifiers: Surface properties, Rectangular bodies.

The scattering of infinitesimal surface waves normally incident on a rectangular obstacle in a channel of finite depth is considered. A variational formulation is used as the basis of numerical computations. Scattering properties for bottom and surface obstacles of various proportions, including thin barriers and surface docks, are presented. Comparison with experimental and theoretical results by other investigators is also made.

W70-06184

8C. Hydraulic Machinery

AUTOMATED VARIABLE FLOW FOR PILOT PLANTS,

Minnesota Univ., Minneapolis.

For primary bibliographic entry see Field 05D.

W70-06051

THE UNDERGROUND POWERPLANT,

International Power and Engineering Consultants Ltd., Vancouver (British Columbia).

For primary bibliographic entry see Field 08E.

W70-06242

CAVITATION MEASUREMENT ON WATER TURBINES,

Central Research Inst. of Electric Power Industry, Tokyo (Japan).

Haruyuki Suzuki, and Akihiko Aihara.

Water Power, Vol 22, No. 1, p. 10-15, Jan 1970. 6 p, 16 fig, 1 tab.

Descriptors: *Cavitation, *Hydraulic turbines, Measurement, Sound waves, Measuring instru-

ments, Laboratory tests, Field tests, Vibrations, Foreign research, Oscillographs, Experimental data, Turbine runners, Oscillation, Francis turbines, Ultrasonics, Acoustic equipment. Identifiers: Japan, *Cavitation noise, Cavitation parameters, Test results, Turbine efficiency, Air admission, Ultrasonic cavitation tests.

A method of detecting cavitation in water turbines under operating conditions is described. Relative intensity of cavitation can be determined by measuring the intensity of ultrasonic waves generated by cavitation. By adopting this measuring method, various aspects of cavitation under different conditions were visually observed during laboratory tests, while at the same time the intensities of the ultrasonic waves from cavitation were measured. After establishing this relationship, measurements of cavitation in many water turbines were performed. Results of measurements on full-scale turbines are given. (USBR)

W70-06244

THERMODYNAMIC EFFICIENCY TESTS ON MURRAY 1 TURBINES,

Glasgow Univ. (Scotland).

A. S. Thom, and T. R. Foord.

Water Power, Vol. 21, No. 12, p. 474-478, Dec. 1969. 5 p, 1 fig, 6 photo, 2 tab, 3 ref.

Descriptors: *Hydraulic turbines, *Efficiencies, Test procedures, Guide vanes, Acceptance testing, Maintenance, Theory, Calorimeters, Temperature, Temperature sensors, Bridges (Electric), Draft tubes, *Turbines, *Francis turbines.

Identifiers: *Turbine efficiency, Murray 1 Proj (Australia), Australia, *Thermodynamic method, Temperature rise, Test results, Foreign testing.

Efficiency tests to determine the effect of guide vane alteration were performed by the thermodynamic method on three 100-mw Francis turbines at the Murray 1 Project, Australia, before acceptance of the machines. The theory involved in making these tests, apparatus used, test procedures, and results are described. The tests demonstrate the ease and simplicity of application of the thermodynamic method as an absolute and as a comparative method, and its suitability for contractual and maintenance tests on hydraulic turbines at hydroelectric plants. (USBR)

W70-06245

THE PEACE RIVER PROJECT—FROM FEASIBILITY REPORT TO FIRST POWER OUTPUT,

International Power and Engineering Consultants Ltd., Vancouver (British Columbia).

W. F. Miles.

Engineering Journal, Canada, Vol 52, No 10, p 12-24, Oct 1969. 13 p, 10 fig.

Descriptors: Feasibility studies, History, *Foreign projects, *Foreign construction, Foreign design practices, Hydroelectric plants, Spillways, Projects, Earth dams, Transmission lines, *Hydroelectric power.

Identifiers: W A C Bennett Dam (Canada), Portage Mountain Dam (Canada), Portage Mountain Pwrpl (Canada), Canada, *Peace River Proj (Canada).

A history is given of the Peace River Project, including a general description of principal components—the Portage Mountain Development, Site 1 Development, and the 500-kv transmission lines to the lower mainland of British Columbia. The height of W A C Bennett Dam (600 ft), the capacity of the reservoir (57 million acre-ft), and the capacity of the underground power facilities (2270 megawatts) combine to place the Peace River Project among the larger hydroelectric projects in the world. Changes made from the original feasibility concept of the project prepared in 1959, and some organizational and administrative aspects of construction of Portage Mountain Development are discussed. (USBR)

W70-06251

TRANSISTORIZED GROUND-FAULT INTERRUPTER REDUCES SHOCK HAZARD,

California Univ., Berkeley.

Charles F. Dalziel.

Inst Elec Electron Eng Spectrum, Vol 7, No 1, p 55-62, Jan 1970. 8 p, 12 fig, 6 ref.

Descriptors: *Safety, *Electric currents, *Interrupters, Fires, Faults (Electrical), Transistors, Electric relays, Electric wires, Hazards.

Identifiers: *Electric shock, Industrial equipment, *Protection (Electrical), Magnetic amplifiers, Ground currents.

A ground-fault interrupter (GFI) is a device that interrupts an electric circuit when the fault current exceeds a predetermined value less than that required to operate the overcurrent devices of the circuit. Recently, developments have been made of 2- and 3-wire transistorized GFI's having a continuous rating of 100 or 200 amp and a ground-current trip value of 5 milliamperes. The operating time of these devices is so fast, and the corresponding shock energy so small, that the modern GFI's virtually eliminate electrocutions, burndowns, and fires caused by currents flowing to ground. The sensitive ground-fault mechanism does not respond to line-to-line or 3-phase faults unless zero phase-sequence currents are involved. Several types of interrupters are described, and results of human and animal shock testing are discussed. (USBR)

W70-06255

AIR POLLUTION AND ATOMIC POWER,

For primary bibliographic entry see Field 05G.

W70-06259

STABILITY AND VOLTAGE REGULATION OF LARGE TURBO-ALTERNATORS IN POWER SYSTEMS: EFFECT OF MACHINE DATA AND EXCITATION SYSTEMS,

Brown, Boveri und Cie, A. G., Mannheim (West Germany); and Brown, Boveri and Co. Ltd., Baden (Switzerland).

D. Oeding, and P. Nemetz.

Conf Pap No 70 CP 199 - PWR, Inst Elec Electron Eng Winter Power Meet, New York, NY, Jan 1970. 10 p, 16 fig, 4 tab, 14 ref.

Descriptors: *Electric generators, *Electrical stability, *Excitation, Voltage regulators, Reactance, Digital computers, Transients, Computer programs, Diodes (Electron tubes), Faults (Electrical), Characteristics, Voltage regulations, Foreign research, Capacitance, Inductance, Simulation, Mathematical models.

Identifiers: *Thyristors, Short circuits, Switzerland, Transient stability, Germany.

Steady-state and transient stability and the voltage regulation of large turboalternators, connected to power systems with different reactances and time constants and different excitation systems, are investigated using digital computer programs. Digital programs used for simulation of a synchronous machine, the excitation equipment, and the system connection are described. The effect of excitation systems on the operating characteristics of machines with either a rotating a-c exciter and diodes or with thyristors fed from the generator terminals is shown when the value of the transient reactance increases. The improvement of machine operating characteristics by supplementary signals depending on rotor slip and acceleration is discussed when thyristor excitation from the generator terminals is used to excite large standard generators. (USBR)

W70-06261

AGING IN ROTATING MACHINERY INSULATING MATERIALS,

Westinghouse Electric Corp., East Pittsburgh, Pa.; General Electric Co., West Lynn, Mass.; and Naval Ship Research and Development Center, Annapolis, Md.

J. C. Botts, E. A. Boulter, and R. J. Flaherty.

Field 08—ENGINEERING WORKS

Group 8C—Hydraulic Machinery

Conf Pap No 70 CP 59 - PWR, Inst Elec Electron Eng Winter Power Meet, New York, NY, Jan 1970. 6 p.

Descriptors: *Aging (Physical), Temperature, *Evaluation, Standards, Test procedures, Physical properties, Thermal properties, Electrical coronas, Materials testing, *Electric generators, *Electric motors, *Electric insulation.

Identifiers: *Rotating machines, *Test codes, Operating temperature, Synchronous machines, Service life.

The modern history of progress in evaluating rotating machinery insulation materials and systems is summarized. Changes in properties of insulation under service conditions and the development of accelerated functional tests for establishing materials indices and insulation systems classification are reviewed. The Rotating Machinery Insulation Subcommittee and its working groups have developed several new test guides and standards, extending older concepts of insulation evaluation to new classes of rotating machines and introducing new concepts of functional aging tests. A listing and current status of the Institute of Electrical and Electronic Engineers and International Electrotechnical Commission test guides and standards for rotating machines are included. (USBR)

W70-06262

8D. Soil Mechanics

THE STRENGTH AND CREEP OF FROZEN SOILS AND CALCULATIONS FOR ICE-SOIL RETAINING STRUCTURES,

Cold Regions Research and Engineering Lab., Hanover, N.H.

S. S. Vyalov, V. G. Gmoshinskii, S. E. Gorodetskii, V. G. Grigorieva, and Yu K. Zaretskii.

Available from the Clearinghouse as AD-484 093, \$3.00 in paper copy, \$0.65 in microfiche. Izdatel'stvo Akademii Nauk SSSR, Moscow, 1962. CRREL-Trans-76, September 1965. 324 p, 82 ref.

Descriptors: *Frozen soils, *Permafrost, Soil engineering, Soil mechanics, Construction materials, Soil structure, Foundations, Mining engineering, Walls, Rheology, Deformation, Stress, Mechanical properties, Creep, Test procedures, Failure (Mechanics), Moisture, Ice, Particle size, Tundra, Frost, Soil texture.

Identifiers: Soil engineering.

Since frozen soils are relatively strong and watertight, they may be used successfully as materials for various types of engineering construction. For example, artificially frozen soils may be used as retaining structures during mining and under complex hydrogeological conditions for sinking open-shafts. When plans and static calculations are being made for constructions on frozen soils, it is necessary to take into consideration the specific properties of such soils. The strength and deformation properties of frozen soils depend essentially upon soil-temperature, soil-composition, and soil-texture (grain-size distribution, moisture content, ice content, frost texture, etc.). Furthermore, the stress-deformation characteristics of frozen soils depend to a very large degree upon the time factor. Since ice and unfrozen water are present, the soils possess clearly defined rheological properties, such as increasing deformation with time (creep), and relaxation and reduction of strength. This book is devoted to the study of the rheological properties of frozen soils and to the development of methods for calculating creep and long-term strength of retaining structures made from artificially frozen soils.

W70-05968

LAND SUBSIDENCE DUE TO THE APPLICATION OF WATER,

Geological Survey, Sacramento, Calif.

Ben E. Lofgren.

Reviews in Engineering Geology II, Geological Society of America, p 271-303, 1969. 33 p, 10 fig, 3 plate, 2 tab, 42 ref.

Descriptors: *Land subsidence, *Compaction, *Infiltration, Permeability, Pore pressure, Soil physical properties, Engineering geology, Foundations, Particle size, Particle shape, Clays, Clay minerals, Soils.

Identifiers: Hydrocompaction.

Loose, dry, low-density deposits that compact when they are wetted mantle extensive areas in North America, Europe, and Asia. This process, here referred to as hydrocompaction, has produced widespread subsidence of the land surface. Hydrocompaction may occur under natural overburden load or may occur only with the addition of a surcharge load. Deposits that subside because of hydrocompaction are generally one of two types: (1) loose, moisture-deficient alluvial deposits; and (2) moisture-deficient loess and related eolian deposits. Such deposits occur in regions where seasonal rainfall seldom, if ever, is sufficient to penetrate below the root zone; thus, they have remained moisture deficient throughout their post-depositional history and are readily susceptible to hydrocompaction when they are artificially wetted. Subsidence due to hydrocompaction is of serious concern in the design and maintenance of aqueducts, buildings, pipe lines, highways, and other major engineering structures. Damage usually can be minimized by precompacting the deposits before construction begins. (Knapp-USGS)

W70-06150

W A C BENNETT DAM,

International Power and Engineering Consultants Ltd., Vancouver (British Columbia).

H. Taylor.

Engineering Journal Canada, Vol 52, No 10, p 25-34, Oct 1969. 10 p, 12 fig, 1 tab, 6 ref.

Descriptors: *Earth dams, Zoned embankments, *Dam design, Performance, Dam foundations, Stability analysis, Seismic design, Seepage, Settlement (Structural), Foreign construction, *Dam construction, Drainage systems, Earth materials, Instrumentation, Geology, Grout curtains, Hydrostatic pressure, Soil investigations, Transition zones, Soil compaction.

Identifiers: *W A C Bennett Dam (Canada), Design modifications, Drain holes, Seismic stability, Blanket grouting, Dam stability.

W A C Bennett Dam (formerly Portage Mountain Dam) is a 600-ft-high, zoned earthfill dam, constructed across the Peace River Canyon in Canada. Site geology, foundation treatment, embankment design procedures, materials exploration, changes made during construction, instrumentation, and performance of the dam are discussed. The dam has a wide central core of silty sand. Downstream from the core are transition, filter, and drainage zones. The upstream and downstream shells are random gravelly fill. Materials for the dam were obtained from 2 large moraines located about 4 mi from the damsite. Materials were processed for the core, transition, filter, and drainage zones. Random fill was pit run. The dam foundation consists of thick beds of sandstone separated by relatively thin beds of shale and coal. Preparation of the bedrock surface was confined to the core contact area and consisted of removing weathered and fractured rock, shaping the canyon walls, and blanket grouting. The foundation was curtain grouted up to 350 ft deep for the full length of the dam. Drainage tunnels and drain holes were provided in the abutments to reduce hydrostatic pressures downstream from the grout curtain. (USBR)

W70-06250

RECLAMATION AND REUSE - THE STATE OF THE ART,

Los Angeles County Sanitation District, Calif.

John D. Parkhurst.

Report No 16, Proc Water Qual Manage Symp, Univ Calif, Davis, June 1969. 12 p, 2 tab.

Descriptors: *Reclaimed water, *Water reuse, Reviews, Water treatment, Demineralization, *Waste water treatment, Electrodialysis, California, Sewage treatment, Treatment facilities, Sanitary engineering, Separation techniques, Spreading basins, Water quality, Filtration, Ion exchange, Tertiary treatment, Nutrients, Nitrates, Phosphates, Reverse osmosis.

Identifiers: Renovating.

The sewerage system of the Los Angeles County Sanitation Districts serves about 4 million people in 71 incorporated cities and large tracts of unincorporated areas. Because of the serious problems caused by water shortage in these heavily populated areas, the sanitation districts have instituted the latest techniques and facilities in water reclamation. The Whittier Narrows Plant, the Pomona research and demonstration program, and the Lancaster project provide sound data for future planning of similar facilities. The initial stages of the 40-yr master plan that will provide approximately 440 mgd of potentially reusable water in the districts' system are underway. The sanitation districts in Los Angeles County are pursuing research and pilot scale operations of various tertiary treatment processes to provide reclaimed water of any desired quality. Descriptions are given of the processes being used. (USBR)

W70-06260

8E. Rock Mechanics and Geology

THE UNDERGROUND POWERPLANT,

International Power and Engineering Consultants Ltd., Vancouver (British Columbia).

H. Lauga.

Engineering Journal, Canada, Vol 52, No. 10, p. 35-42, Oct. 1969. 8 p, 7 fig.

Descriptors: *Underground powerplants, Underground structures, Design, Tunnels, *Penstocks, Intake structures, Geologic investigations, Foreign construction, Grouting, Powerhouses, *Hydroelectric plants, Tailrace, Rock bolts, Fabrication, Mechanical equipment, Electrical equipment, Structural design.

Identifiers: Bellmouths, *Peace River Proj (Canada), Manifolds, Canada, Earthquake loads, Electroslag welding, Portage Mountain Pwrplt (Canada).

In the Portage Mountain Development in Canada, the water passages and power generating units are located underground. The powerhouse was designed to house 10 vertical-shaft Francis turbines and directly connected generators, each rated at 227,000 kw. The main structural aspects of the power intakes and the principal components of the underground complex including the penstocks, powerhouse, and manifolds are described. Road and railroad limitations required penstock sections to be fabricated at the site. Electroslag welding was used to fabricate 24-ft-long penstock sections from the 8-ft-long half-can plates supplied by the fabricator's shop. Penstock plate thickness varies from 2 in. at the powerhouse to 1-1/2 in. for the upstream end. The geological investigations required for the powerhouse are discussed. Approximately 1,000,000 cu yd of rock were removed to complete the underground excavation for the powerplant, and approximately 400,000 cu yd of concrete will be placed before completion. (USBR)

W70-06242

8F. Concrete

CONCRETE PERFORMANCE IN GLEN CANYON DAM, ARIZONA - 5-YEAR CORE REPORT,

Bureau of Reclamation, Denver, Colo.

J. R. Graham.

Education (Extramural)—Group 9A

Bur. Reclam Report C-1067A, Oct. 1969. 22 p, 10 fig, 9 tab, 3 ref.

Descriptors: *Concretes, *Compressive strength, Poisson ratio, *Mass concrete, Concrete control, Elasticity modulus, *Concrete dams, Concrete testing, *Cores, Laboratory tests, Pozzolans, Concrete mixes, Aging (Physical), Concrete technology. Identifiers: *Concrete properties, Glen Canyon Dam, Colorado River Storage Proj, Longtime tests.

Results of physical properties tests conducted on cores drilled from mass concrete in Glen Canyon Dam, Ariz, at 6 mo and 1, 2, and 5 yr age indicate a good-quality, uniform, well-consolidated concrete exceeding established design criteria. The study is part of a series in the Bureau of Reclamation's 20-yr evaluation of strength and elastic properties of concrete in various dams. Average 5-yr compressive strength was 5220 psi for interior concrete and 5640 psi for exterior concrete. Average 5-yr moduli of elasticity of the interior and exterior concretes were 6.07 and 6.29 million psi, respectively. Cement efficiencies, coefficient of variation of strengths, and Poisson's ratios are discussed. (USBR)
W70-06247

SOME FIELD EXPERIENCE IN THE USE OF AN ACCELERATED METHOD OF ESTIMATING 28-DAY STRENGTH OF CONCRETE,
Department of Energy, Mines and Resources, Ottawa (Ontario).
V. M. Malhotra, and N. G. Zoldner.
Digest Suppl, Amer Concr Inst J Proc, Vol 66, No 11, p 894-906, Nov 1969. 20 p, 15 fig, 6 tab, 11 ref, append.

Descriptors: *Concrete testing, Estimating, Test specimens, Strength, *Test procedures, Compressive strength, Field tests, Testing, Concrete technology, Laboratory tests, Concrete mixes. Identifiers: *Accelerated testing, *Boiling method (Concrete), Foreign testing, Canada, Test results, Concrete properties.

Since 1963, the Department of Energy, Mines and Resources, Ottawa, Canada, has been engaged in developing an accelerated test for estimating the 28-day compressive strength of concrete. Results of the research work were presented at the 17th ACI Fall Meeting at Miami, Fla, in Nov 1964. The method, known as the modified boiling method, consists of standard moist-curing of test specimens for 24 hr, followed by boiling in water for 3-1/2 hr, and testing for compression 1 hr later. The method was selected by the ASTM as one of the 3 most promising methods for an international cooperative testing program. Since the introduction of the method, several ready-mixed concrete producers in Newfoundland, Quebec, and Ontario, testing companies in Quebec and British Columbia, and provincial and municipal authorities in Quebec have installed suitable equipment. The method has been used, with and without modification, as a routine control test. One Federal agency has subjected the method to further laboratory testing. Data obtained by organizations using the accelerated testing method are reviewed. (USBR)
W70-06252

TORSIONAL STRENGTH AND BEHAVIOR OF SPANDREL BEAMS,
Rice Univ., Houston, Tex.; and Arkansas Univ., Fayetteville.
James O. Jirsa, John L. Baumgartner, and Nathan C. Mogbo.
J Amer Concr Inst Proc, Vol 66, No 11, p 926-932, Nov 1969. 7 p, 6 fig, 4 tab, 12 ref.

Descriptors: *Beams (Structural), *Torsion, Cracking, Moments, Strain, Reinforced concrete, Shear stress, *Structural behavior, Rotation, Test procedures, Structural members, Structural models, Deflection, Twisting, Structural engineering, Stress, *Model tests, Twisting stress, Slabs, Columns. Identifiers: *Spandrel beams, Concrete slabs, Ultimate strength.

Nine specimens simulating the edge of a floor slab structure adjacent to an exterior column were tested to determine the torsional strength and behavior of typical spandrel beam configurations. The influence of the slab on the torsional strength and on the mode of failure of the spandrel beam was examined. Effects of shear-torsion and moment-torsion interaction on the torsional strength of the spandrel beam were estimated. Applicability of equations developed previously by other investigators for the torsional strength of isolated beams was examined. The behavior of the spandrel beams indicates that the slab does not participate directly in resisting the applied torsional forces; the beam may be considered as a rectangular cross section in computing torsional strength. Under the loading conditions used, the slab appeared to contribute indirectly to the torsional strength of the beam by restraining the beam against longitudinal extension under torsional deformation and thereby exerting an axial force on the beam. The torsional strength using equations developed by Collins and Hsu was conservative for the specimens tested. (USBR)
W70-06253

THE USE OF MODEL TESTS IN THE DETERMINATION OF THE SAFETY FACTOR IN ARCH DAMS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 08A.
W70-06254

THE PRODUCTION AND PROPERTIES OF HIGH-STRENGTH CONCRETE,
Cement and Concrete Association, London (England).
L. J. Parrott.
Concrete, Vol 3, No 11, p 443-448, Nov 1969. 6 p, 6 fig, 2 tab, 4 ref.

Descriptors: Concretes, *Concrete technology, *Concrete mixes, Concrete structures, Concrete testing, Foreign research, Portland cements, Coarse aggregates, Crushed stones, Mechanical properties, Creep, Physical properties, Compressive strength, Tensile strength, Heat of hydration, Shrinkage, Elasticity (Mechanical), Costs, Workability. Identifiers: *High strength concretes, Structural concrete, Great Britain.

Experimental work demonstrates the feasibility of making concrete with 28-day cube strengths of 11,600 psi, using a wide range of constituents. Strengths of 13,100 to 14,500 psi are attainable with a limited range of constituents without recourse to unusual materials or processing methods and without incurring significant technical penalties. Crushed rock such as hard limestone, granite, basalt, or dolerite is suitable coarse aggregate for high-strength concrete. Selective cement may be necessary to produce concrete of strengths above 13,100 psi. Mix design, workability, costs, compressive and tensile strengths, elasticity, shrinkage, creep, heat of hydration, thermal expansion, and density are discussed. The work described should provide sufficient information for estimating the usefulness of high-strength concrete in most structures. If a precise estimate is required, further studies should be made on: (1) effects on creep of stress level and age at loading, (2) movements at early ages in restrained and unrestrained structural elements, (3) short-term and long-term loading tests, and (4) site trials to determine placing and compacting costs. (USBR)
W70-06256

8G. Materials

HOW TO INSTALL FLEXIBLE MEMBRANE CANAL LININGS,
For primary bibliographic entry see Field 03F.
W70-06007

IN-SITU-FABRICATED MEMBRANES,
Witco Chemical Corp., New York. Pioneer Div.; and Witco Chemical Corp., New York. Research and Development Lab.
For primary bibliographic entry see Field 04A.
W70-06017

ECONOMIC COMPARISONS OF OPEN CONDUIT AND PIPE IRRIGATION DISTRIBUTIONS SYSTEMS,
Bureau of Reclamation. Div. of Irrigation Operations.
For primary bibliographic entry see Field 03F.
W70-06025

AGING IN ROTATING MACHINERY INSULATING MATERIALS,
Westinghouse Electric Corp., East Pittsburgh, Pa.; General Electric Co., West Lynn, Mass; and Naval Ship Research and Development Center, Annapolis, Md.
For primary bibliographic entry see Field 08C.
W70-06262

8I. Fisheries Engineering

THE CREATION OF SPAWNING FIELDS IN RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Narragansett, R.I. Narragansett Marine Game Fish Research Lab.
F. Nezhivenko.

Available from the Clearinghouse as PB-189 113T, \$3.00 in paper copy, \$0.65 in microfiche. Translation from Rybnde Khozyaistvd, Vol. 45, No. 2, Feb 1969. 2p.

Descriptors: *Spawning, *Fish farming.

In the middle and lower section of Kremenchugskoe Reservoir, as well as in many other reservoirs, essentially there is no substrate for the deposit of spawn by fish during spring spawning. At the Cherkasskii Fishermans Collective Named after Shevchenko, based on perennial observations on fish spawning, the conditions of spawn incubation on nests, and emergence of the fry of the fish, a method has been developed for the creation of whole spawning fields. Artificial shrubs form the basis of these fields. (Author)
W70-06030

REGULATIONS APPLYING TO SPECIFIC VARIETIES OF FISH.
For primary bibliographic entry see Field 06E.
W70-06191

DISTINCTIVE ASPECTS OF THE ECOLOGY OF STREAM FISHES: A REVIEW,
Fisheries Research Board of Canada, Nanaimo (British Columbia). Biological Station.
For primary bibliographic entry see Field 06G.
W70-06220

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WATER RESOURCES RESEARCH IN OKLAHOMA,
Oklahoma Water Resources Research Inst., Stillwater.
For primary bibliographic entry see Field 09D.
W70-06027

Field 09—MANPOWER, GRANTS AND FACILITIES

Group 9A—Education (Extramural)

ANNUAL REPORT OF WATER RESOURCES RESEARCH ACTIVITIES UNDER PUBLIC LAW 88-379, FISCAL YEAR 1969.

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

Available from the Clearinghouse as PB-191 166, \$3.00 in paper copy, \$0.65 in microfiche. Virginia Polytechnic Institute Water Resources Research Center Report, 1969. 118 p, 7 fig, 12 tab. OWRR Project A-999-VA.

Descriptors: *Water resources, *Research and development, *Water resources research act, *Virginia, Colleges, Contracts, Grants, Water pollution control, Evapotranspiration, Evapotranspiration control, Small watersheds, Hydrologic cycle, Water balance, Mathematical models, Water quality, Estuaries, Streams, Water wells, Aquifers, Groundwater, Surface waters.

Identifiers: Virginia Polytechnic Institute.

A summary of the fifth Annual Report was submitted to the Office of Water Resources Research by the Water Resources Research Center, Virginia Polytechnic Institute. Research of F. Y. 1969 included: Removal of Trace organics from Water by adsorption on coal; microbial release of soluble phosphate in activated sludge; solar reflectance of monolayer-covered water surfaces; evaporation suppression; digital simulation of the hydrologic cycle on small agricultural watersheds; perception of water resource problems; stochastic models for pollution and dissolved oxygen in streams; adsorption of organic compounds onto solids; groundwater reservoir response to earth tides; invasion of the aquatic habitat by amphibious species of polygonum; treatment of dyeing bath wastes by foaming and flotation; effects of zooplankton on photosynthesis by algae in lakes; and biological and chemical studies of Virginia's estuaries. Training and education aspects of the water resources research program are listed, as well as publications and theses resulting from all WRRC studies. (Knapp-USGS) W70-06028

SERVICE TO NEW YORK STATE: A SUMMARY REPORT 1965-69.

Cornell Univ Water Res and Marine Science Center, Service to New York State, Summary Rept, pub 28, Nov 1969, 52 p, 5 app.

Descriptors: *New York, *Water Resources Research Act, *Water resources planning, *Universities, Engineering, Agriculture, Economics, State governments, Public health, Regional analysis, Grants, Research facilities, Great Lakes, Administrative agencies, Water pollution control, Water demand, Human population, Industrial plants, Legal aspects, Colleges, Allotments.

Systems analysis, Federal government, Research and development.
Identifiers: *Water research centers.

To provide for graduate education and research, Cornell University established a Water Resources Center in 1962. Topics of central concern to the Center were: (1) water supply and demand of New York and the Northeast; (2) water law and institutions; (3) studies of the Great Lakes and Finger Lakes of New York; (4) relevant aspects of pollution, land use, economics, government, and public health; and (5) application of systems-analysis techniques to improve water management. In 1965 the Center won federal support under the Water Resources Research Act. In 1968 the Center undertook studies in marine research and was renamed the Cornell University Water Resources and Marine Sciences Center. This Report describes the sources of research programs and their relevance to New York state. Listed are research reports, publications and recommendations resulting from the studies. (Hubener-Florida) W70-06198

EDUCATING THE PUBLIC IN NATURAL RESOURCES,
Wisconsin Univ., Madison. Dept. of Journalism; and Wisconsin Univ., Madison. Dept. of Wildlife Ecology.
For primary bibliographic entry see Field 05G.
W70-06228

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES RESEARCH IN OKLAHOMA.

Oklahoma Water Resources Research Inst., Stillwater.

Available from the Clearinghouse as PB-191 216, \$3.00 in paper copy, \$0.65 in microfiche. Oklahoma Water Resources Research Institute Report, (1969). 48 p. OWRR Project A-999-OKLA.

Descriptors: *Allotments, *Grants, *Research and development, *Universities, Colleges, Facilities, Institutions, Laboratories, Professional personnel.

This brochure is an attempt to describe some of the centers of water research and some of the projects which are currently underway in Oklahoma or which have been recently completed. It is hoped that this brochure will not only be information to the general public, but that it will also acquaint

many scientists with related communications, reports of other organizations and federal catalogs especially Volume 3 of the Water Resources Research Catalog. W70-06027

ANNUAL REPORT OF WATER RESOURCES RESEARCH ACTIVITIES UNDER PUBLIC LAW 88-379, FISCAL YEAR 1969.

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
For primary bibliographic entry see Field 09A.
W70-06028

SERVICE TO NEW YORK STATE: A SUMMARY REPORT 1965-69.

For primary bibliographic entry see Field 09A.
W70-06198

10. SCIENTIFIC AND TECHNICAL INFORMATION

WATER RESOURCES REPORTS AND PAPERS IN THE J. B. LIPPINCOTT COLLECTION, CALIFORNIA UNIV., BERKELEY.

Gerald J. Giefer, and Anelle McCarty Kloski. Water Resources Center Archives Series Report No 21, California University, Berkeley, January 1970. 301 p.

Descriptors: *Bibliographies, *Libraries, Universities, Documentation, Publications, Water resources development, Hydrology, Hydraulics, Surveys, Investigations, Geology.
Identifiers: *J. B. Lippincott collection.

This is an annotated listing of reports, papers and photographs in the J. B. Lippincott collection, Water Resources Center Archives, University of California, Berkeley. The collection is arranged in the order in which it was kept by Mr. Lippincott, i.e., alphabetically by name of contracting agency, project title, or geographical entity. Manuscript materials in the collection of the Water Resources Center Archives cannot be loaned. Arrangements can be made to photocopy items of interest. (Knapp-USGS) W70-05914

THE EFFECTS OF ELEVATED TEMPERATURE UPON AQUATIC INVERTEBRATES--A REVIEW OF LITERATURE RELATING TO FRESH WATER AND MARINE INVERTEBRATES.

John Hopkins Univ., Baltimore, Md. Dept. of Geography.
For primary bibliographic entry see Field 05C.
W70-05962

BENTHIC MACROINVERTEBRATES AND PERIPHYTON.

Midwest Benthological Society.
For primary bibliographic entry see Field 05C.
W70-05989

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